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THE OUTLOOK FOR FIXED OILS.

With copra only two-thirds the price of what it was a year ago, the prospect for fixed oil-producing seeds may not at the moment seem very bright especially as the decline in price set in before the war; but the fact is, we believe, that the future for vegetable oils contains the elements of stability to a degree greater than that of most other major products of tropical agriculture. Science is making rapid advance in overcoming the objections to vegetable oils by depriving them of their unpleasant odours and especially by converting them into solid fats which can be used in soap making and possibly even in the preparation of margarine. Concurrently with progress made, vegetable oils and fats will gain in popularity as food not only because they are cheap, but also because they naturally enjoy more freedom from suspicion as disease carriers than fats and oils derived from the animal kingdom. Lubricants and drugs will probably share in any appreciation in price earned by fixed oils generally. From the producers' point of view commercial oil seeds may be arranged in three classes. Firstly, of those mainly derived from forest or uncultivated trees one only need engage our attention for the present and that is palm oil seed. This product is certainly worth and is receiving study from planters. We have seen one industry of the West overthrown or nearly so by planters of the East : does a like fate await the palm oil seed industry of the West Coast of Africa ? As to this we will only venture the belief that industries carried on in ordered plantations will always in the end prevail over those that depend upon natural forests, in which trees are often widely scattered and immense distances have to be traversed. When, as in the East, plantations have densely populated countries to draw upon for labour they become very dangerous rivals.

In the second category of tropical oil products, namely those produced from cultivated trees, the coconut may be said to enjoy a position almost by itself, and commanding as it does our perpetual study need not detain us here ; our object being to direct attention more particularly to annuals which especially in Ceylon are neglected. We do not know of any annual oil-producing tropical product sufficiently remunerative to attract the large employer of labour. Unless he uses machinery for cultivating, harvesting and threshing, which he does not as yet do but has to depend upon hand labour, annuals whether oil seeds or other products are for him generally too expensive to touch as prime products. For this reason the attention now being given in some countries to oil-producing annuals like linseed in anticipation of a rising demand for vegetable oils and fats is of interest mainly to the peasant cultivator. Sesamum (gingelly) is the only annual (we are referring of course to oil seeds) systematically cultivated in Ceylon on a considerable scale, but there are others which we believe have possibilities notably castor seeds, which though the weight per acre obtained is not great, possess the advantage of being large seeds which can be picked or swept up on the ground and not lost if shed as in the case of gingelly. Ground-nuts being a low creeping crop liable to be smothered demand a lot of labour in weeding as also in harvesting, practically every nut having to be picked. For this reason it is questionable whether the industry would appeal to favoured countries like Ceylon, but must not be left to develop in countries where it has chiefly taken firm root; though on the other hand it is worth more attention than it is receiving. Soya beans must also be tried again at different elevations. One of the richest oil seeds known to commerce is the Inhambane nut *(Telfairia pedata)* which though not an annual may be classed in this category. The kernel contains about 60 per cent. of oil. The seed is enveloped in a fibrous husk and a shell (as in case of the coconut) difficult to decorticate, and is therefore shipped husk and all to the detriment of price. It is a mighty climber demanding for its accommodation large trees which it suffocates in time with its deadly embrace, but it might prove feasible to keep it under reasonable control like other cucurbitous plants to which it is allied. It is being sown at Peradeniya. Linseed to which increased attention is being devoted in many countries is also being tried at Peradeniya, Anuradhapura, Nuwara Eliya, and Hakgala. It is a temperate and sub-tropical rather than a tropical product, more suited probably to our medium and high elevations than to the low country. We recommend it for trial by members of the Ceylon Agricultural Society.

R. N. L.

RUBBER.

THE LATEST SYNTHETIC RUBBER.

Some few months ago considerable interest was aroused amongst those connected with the rubber industry in the Island by the announcement that a well-known English firm of manufacturers of rubber goods were extensively utilising a form of synthetic rubber and that they considered that the "synthetic" problem had been solved.

Small samples only, however, were sent into the outer world and one or two found their way to Colombo. The general comment in the Fort is said to have been that the samples very closely resembled scrap crepe and doubts were cast upon the sense in which the rubber was truly "synthetic."

The synthetic rubber was on view at the Rubber Exhibition held in London in July and evidence of its synthetic nature is said to have been supported by a "strong smell of pear drops." We have to hand, however, a most interesting report on samples submitted to a chemist for examination and issued with the compliments of the selling agents.

In the first place the ordinary rough analysis was made and found to correspond with that of Hevea rubber. A number of tests were then made and the results in each case compared with those given by Fine Hard Para and Smoked Sheet.

Acidity. "No trace of acid was present in any of the Synthetic samples examined."

The author remarks that this fact speaks for itself when one considers the amount of acid present in many plantation rubbers It has been fairly well proved, however, that plantation rubber does *not* contain as much acid as Fine Hard Para.

Acetone Extract, Saponification and Water Extract were of the same order in all three cases. The Ash of the Synthetic rubber was somewhat higher than those of either the Fine Hard or Smoked Sheets.

The nitrogen was present in about the same quantity as in Fine Hard.

Influence of Heat. Pieces of equal thickness were placed in a hot-air oven which was kept at 110° and at stated intervals samples were withdrawn, the acetone extract being immediately determined.

After heating for 300 hours the synthetic sample on extraction with acetone lost 18·54 per cent., Fine Hard 19·01 per cent., Smoked Sheets 24·21 per cent.

Exposure of Raw Rubber to Ultra Violet light. The effect was found to be about the same as in the case of Fine Hard.

Exposure of Vulcanised Rubber to Ultra Violet light. In this case the effect was less marked in the case of synthetic than that observed in the case of the other rubbers.

Mechanical Tests—Tensile Strength and Elongation.

"The Synthetic Rubber requires a longer period of vulcanisation than Para, to obtain the maximum efficiency." A number of mixings were made, containing varying proportions of rubber filling materials and sulphur.

The Synthetic gives a figure somewhat higher than Fine Hard though in the abrasion tests it was not so satisfactory.

One of the most interesting parts of the report however is that in which the author observes that the presence of l-methyl inosite "has hitherto only been identified in the rubber obtained from Hevea species, and its occurrence in Synthetic Rubber is indeed remarkable.

"C. O. WEBER states that there is a glucoside present in the latex which on hydrolysis yields l-dimethyl inosite, but whilst this may explain its occurrence in Hevea Rubber, it obviously offers no explanation for the presence of the sugar in the Synthetic product."

This fact of the presence of l-methyl inosite is one of the most startling of the many similarities between this product and Hevea rubber. No explanation of its presence is offered to us.

L. E. C.

LIME SULPHUR WASH AS A PREVENTIVE OF "CANKER" OF PARA RUBBER.

MR. D. EYRE BAXTER of Sarawak has furnished us with the following account of an experiment carried out on the Sungei Tengah and Dahan estates of The Sarawak Rubber Estates Limited during the rainy season of 1913-14 in order to test the value of Lime Sulphur Wash as a preventive of "canker" caused by the fungus *Phytophthora faberi*.

The tree trunks were sprayed with the wash to a height of three feet from the ground, by means of Vermorel "Eclair Etame" knapsack sprayers, using a fine nozzle. Three applications of the Wash were made—at the beginning of October, December and February. The Wash was prepared according to the formula used by MR. E. S. SALMON of the South Eastern Agricultural College, and was diluted for use to a specific gravity of 1·01.

The area taken for experiment at Sungei Tengah was 100 acres and for the control 150 acres. There were 150 trees to the acre. At Dahan the experimental area was 52·85 acres and the control was the same area. The control area was done nothing to and the number of cases of "Canker" was carefully counted every month on both the experiment and the control areas.

Careful records of all diseases are kept: so that a comparison with the year previous is possible.

The following tables show a comparison of results.

Sungei Tengah Estate :—

PERIOD.	EXPERIMENT: 100 ac.		CONTROL: 150 ac.	
	Total Cases.	Cases Per ac.	Total Cases.	Cases Per ac.
Dec. 1912—Apr. 1913.	427	4·27	598	3·98
Dec. 1913—Apr. 1914.	115	1·15	620	4·13

Thus, during the season 1912-13 the experimental area contained more "Canker" than the control, to the extent of 0·29 cases per acre or 7·28%. During the time of experiment the number of cases on the control area increased 0·15 per acre or 3·67% on the number for the previous season. But the cases on the sprayed area decreased by 312 or 73·06 %, and this area contained 2·98 cases per acre or 72·15% less than the control.

Dahan Estate :—

PERIOD.	EXPERIMENT.		CONTROL.	
	Total Cases.	Cases Per ac.	Total Cases.	Cases Per ac.
Previous to Spraying	631	11·93	439	8·30
After Spraying—new cases	807	15·26	922	17·44

The new cases after spraying were 2·18 per acre or 12·36% less on the experimental area than on the control, while previous to spraying there were 3·63 cases per acre or 43·73% more.

The following shows a summary of costs, under estate working conditions, for spraying at Sungei Tengah.

(1) The Wash :—

5 cwt. Sulphur @ 9*s.* 6*d.* per cwt.	£2 7*s.* 6*d.*
2½ cwt. Lime @ 2*s.* 0*d.*	5 0
Total	£2 12*s.* 6*d.*

(2) Labour :—

Making Wash, Transport and Spraying	£8 3*s.* 4*d.*
(3) Depreciation on Machines 10%	£1 15*s.* 0*d.*
Total Cost for Spraying 100 ac. 3 times	£12 10*s.* 10*d.*

Cost per Acre per Spraying—10·03*d.*

On the Sungei Tengah Estate the experiment was carried out on flat land, which is flooded after very heavy rain; and at Dahan the land is hilly.

The difficult nature of the ground to be traversed would make the expenses of the latter estate slightly heavier. At Sungei Tengah one man could spray four acres per day efficiently, while at Dahan three was as much as could be done.

The annual rainfall at Sungei Tengah is about 160 inches—during 1911 there was a fall of 139·81 inches, during 1912 there were 160·12 and in 1913 there were 192·40 inches. The largest quantity of rain falls during the North-East Monsoon, from September to April. During the period of experiment—September 1913 to April 1914—102·45 inches of rain fell.

CONCLUSIONS.

Considering the size of the experiment, and that it was conducted under estate working conditions, it seems fairly safe to say that Lime Sulphur Wash is a preventive of "Canker" caused by *Phytophthora faberi*.

The improvement in the sprayed areas cannot be attributed to weather conditions. The season was normal, and the control areas contained more disease than they did the previous season.

The cost is not excessive. The costs given are the actual figures taken from the estate books.

If alternate-daily tapping is in vogue the operations can be carried out without interference with the ordinary estate work.

As far as could be ascertained the Wash had no detrimental effect on the prepared rubber. At first there was a slight smell of sulphuretted hydrogen, but this was not noticeable when the rubber was dry.

The Government Mycologist, to whom the above was referred, remarked as follows :—

As so many manifestations of disease are attributed to Canker further East it would be of interest to know what symptoms were relied on in the present case. It is not stated whether the diseased trees were treated in any way, e.g., by excising diseased bark, before the spraying experiment was instituted.

THE SYNTHETIC SCARE.

It is nearly two years since we had a synthetic scare. During the past two months the market has been threatened by a new process. Inquiry with regard to it in quarters well informed in all that relates to the chemistry of rubber showed that the newcomer was held in no better esteem than its predecessors. Samples of the material are now on view, and it is stated that an attempt is shortly to be made to raise money from the public. According to market gossip the new material is made from cotton, nitric acid, and artichokes. So wonderfully does the product of these substances resemble fine hard Para that the cleverest rubber chemists—men who are testing and analysing rubber every day of their lives—cannot distinguish it from the Brazilian product. At least, this is the statement as dished up for public consumption by the principal newspapers ; but the mere extravagance of the claim is sufficient to exclude it from notice in the recognised technical journals. Fine Hard Para has a number of characteristic impurities which readily enable the chemist to distinguish it from plantation rubber. Not

only does the new process supply pure rubber, but all the characteristic impurities, it seems, are also synthetically reproduced in so life-like a form as to deceive the expert. It is necessary only to remark at present that the opinion of the chemist who cannot recognise fine hard Para by its impurities is not worth having, and I shall require testimony of a far more convincing character before I proceed to discuss the merits of the synthetic compound as a possible competitor with the natural product.

A sample of synthetic rubber produced in Manchester has found its way to Ceylon, a Fort broker being the recipient. It has gone the round of the firms, and would probably have come in for more consideration had not one merchant cast doubts upon its genuineness. He had it subjected to a test, he said. He burnt a piece of the so-called synthetic rubber and a similar-sized piece of rubber taken from his stock room. The residue left by each piece was exactly the same in substance, smell, and every other particular. While the matter rests at this at present, the Government Chemist is waiting the arrival of a bigger sample, which is understood to be coming out.—GRENIER'S RUBBER NEWS.

WAR AND WOOD PULP.

It is not only in its effect upon the reading public that the war is keeping the book trade in its present state of suspended animation. The question of the paper supply is obviously a very serious one, when so much of the raw material for books comes from abroad in the shape of wood pulp and esparto. Esparto, a grass from the shores of Spain and Northern Africa, preceded wood as a substitute for rag when the supply of that material proved insufficient to meet the increasing needs of the book market. To-day some 200,000 tons of esparto are imported into England, chiefly for this purpose, esparto being especially applicable to the manufacture of book paper. The war will cause the paper maker to turn his attention more closely than ever to the discovery of other possible sources of supply. Wood is not an inexhaustible material. The demand for pulp has increased so vastly that it is now estimated to account for the destruction of something like 50,000,000 trees every year. According to MR. R. W. SINDALL, who has made investigations in this connection on behalf of the Indian Government, the most likely substitute for esparto and wood pulp is bamboo; but experiments are being made with fibrous stock of every description. Meantime the price of paper has gone up, and one of the largest manufacturers for the book trade stated last week that unless fresh supplies of material and chemicals were forthcoming his works would be temporarily shut down before the end of the month. The increase in the price of paper in the book world will naturally fall heaviest of all upon the cheap reprints, especially where these are issued by British houses for Continental editions.—TIMES LITERARY SUPPLEMENT.

COCONUTS.

ADVICE TO COCONUT PLANTERS.

A recent issue of the PHILIPPINE AGRICULTURIST contains a thoughtful article dealing with the present crisis and its bearing on the coconut industry ; and though the advice it contains is intended for the Philippine planter, it is well worth the consideration of local estate owners, to whose benefit we have made the following summary :—

During recent years, with the great development in Europe of industries which required large quantities of coconut oil, the price of copra was nearly doubled with the result that coconut planters reaped immense profits. But the countries which were the largest buyers of copra are now at war and their industries are depressed, so that the demand for coconut products has fallen considerably. Even though the war may be of short duration it will leave France and Germany in an impoverished state, and it will take a long time for the resuscitation of industries which till lately were in a flourishing condition. These countries will have lost their power to pay satisfactory prices even, if they are able to buy, and a return to the recent high prices is not to be expected in the near future.

The coconut industry may therefore be said to be confronted by a more or less acute crisis, and planters must face the fact that even after the crisis is past there will be a comparatively long interval during which their produce must be marketted at low prices, and the world's demand for copra will be a good deal less.

Before the war Europe wanted more copra than the tropics could provide, and while this demand existed it was possible to sell almost any quality of copra, however poor. But now it is to be expected that Europe, being unable to accept all the copra that is offered, will be in a position to choose only the good and reject the inferior. The producer must therefore take steps to meet the present crisis and the future prospect of a poor market. To get past the crisis he must as far as possible delay marketing his produce, and to sell readily afterwards he must market such copra as a depressed market will receive and by producing as good quality stuff as he can.

In order to do this it is suggested that nuts should not be picked but be allowed to fall to the ground, this being the cheaper and more satisfactory method of gathering, inasmuch as the nuts will thus be got more uniformly ripe and in the best condition for copra drying ; and good copra can be kept for a number of months without considerable deterioration. Again perfectly matured nuts can be stored for a long time and still be turned into good copra.

Thus in helping himself to tide over the present crisis and prepare for the depressed market the coconut planter will be adopting measures for raising the standard of his produce. If therefore the present crisis, bad as it is, is likely to result in a permanent improvement of our great coconut industry, it must be looked upon as a blessing in disguise.

The advice given above, which we commend to coconut planters, undoubtedly offers the best hope : but under prevailing conditions it may be questioned whether the plan of allowing nuts to fall to the ground instead of picking them is a practicable one. It has been adopted locally to a very limited extent, as for instance in the Eastern Province, but in densely populated areas as in Western Province it would be possible only where the greatest vigilance is observed owing to the prevalence of prædial thefts.

C. D.

COPRA INDUSTRY IN CEYLON.

The four principal countries which manufacture and export coconut products are the Dutch East Indies, Philippine Islands, Ceylon and India. About thirty per cent. of these products are consumed in Europe and North America, the chief items being copra and coconut oil. The cultivation of coconuts and the preparation of their commercial products are among the leading industries of Ceylon. A study of the methods in vogue in that island, where the industry has been carefully and scientifically built up, may be of some interest. We are indebted for the following particulars to Mr. David S. Pratt of the Laboratory of Organic Chemistry, Bureau of Science, Manila, who has contributed a valuable paper on "The Coconut and its Products with special reference to Ceylon" to the Philippine Journal of Science of last April.

Copra is the kernel of the coconut from which the greater part of the water content has been expelled, either by the natural process of sundrying or by warming over low fires. The method employed in Ceylon is very simple, and consists in merely chopping the nut in half and exposing the hemispheres, meat upward, on dry, sandy ground. The nuts are carefully covered at night and kept free from all dirt. The meat shrinks away from the shells after two days, and is then removed for further drying. The process is usually complete in about six days, whereupon the copra is ready for market. Artificially dried copra is frequently inferior to the sundried product since the heat and smoke give it a darker colour and wizened appearance. Fire drying requires from two to four days in the large mills and from five to seven days on native estates. The latter rate is preferable as it produces a higher grade copra. The process is essentially the same in both cases, differing merely in the rate at which it is carried out. A platform is constructed of green areca-palm (betel-nut palm) laths placed about an inch apart, forming a floor from three to four yards wide and of any desired length. This is erected above an earthen pit in which coconut shells are fired, after having been fitted into each other in parallel rows. Three or four rows of these shells are generally fired at one time, with an occasional reduction of the heat for several hours. A row of shells burns from five to six hours, sometimes much longer. The half nuts on the platform are turned over after the second firing, and the partially dried meat is released after the third. Three more firings complete the drying. When this method is carefully carried out only dry shells are burned, as these produce very little smoke but considerable heat. The husks are employed in the preparation of fibre. The resulting copra is fairly white and clean,

and since it sells for nearly top prices in the London market estate owners are content to use this method as supplementary to sundrying without employing more complex machinery. All Ceylon copra at the present time is prepared by one or both of these processes. A very successful drier claims he can turn out the best white copra by grill drying and more economically than by sundrying. He fires only one row of shells at a time, and requires five days and nights of continuous heating to complete the drying. Many planters start with sundrying and complete the preparation of their copra over grills.

The amount of copra from a given quantity of fresh nuts depends to a considerable extent upon the rate of artificial drying. Ordinarily, from 170 to 200 nuts give about 110 pounds of copra. The two extremes are encountered in comparing the output of sundried copra with that of desiccated coconut products. The relatively low yield of the latter is well known, a decrease of 10 per cent,, based on fresh kernel, not being unusual. The decrease in time required for expelling the water is, therefore, coincident with increased loss of oil, and all methods of preparing copra must represent an economical balance between these factors. It is unquestionably possible to make copra in much less time than is required by either the sundrying or grill-drying processes, but experiments made by planters in Ceylon have not impressed them with the advisability of adopting such changes. One of the most progressive coconut planters in the island constructed a drying house with brick heating flues and produced a paper-white copra in less than twenty-four hours, but discontinued the process because of the resulting high loss of oil. A continuous slow current of air at from about 54° to 6 ° (130° to 140° F.)—the proper temperature to be determined by experiment—should, it is said, complete the drying process within three days and nights, and with the least loss of oil. A rapid drying in ten hours must be attended by a considerable loss, and will require about 15 per cent. more kernel to produce a given weight of copra. The copra destined to be exported to a foreign market for oil making is spread out in warehouses and sorted according to quality, dryness, colour, etc. Each hemisphere is then chopped into three or four pieces and resacked for shipment. The work is largely done by women labourers. This handling and chopping causes a loss in weight amounting to from 0·5 to 1 per cent., and a further loss of from 3 to 5 per cent. is generally allowed for shrinkage during the voyage.—INDIAN TRADE JOURNAL.

EXPERIMENTS ON THE COCONUT.

E. B. COPELAND.

In the study of the physiology of the coconut, the greatest emphasis is given to growth, This is for the sufficient general reason that growth is the most convenient general index to the thriftiness of the plant. It is by no means the only such index, and growth is not in itself the most ultimately important phase of the tree's activity. But the coconut is peculiar among agricultural crops, so far as these are known, in the length of time required before any given kind of treatment or any set of favourable or unfavourable conditions makes itself evident in the yield. A season dry enough to be exceedingly injurious has almost no immediate effect on the yield of nuts, but will result in a long period of poor crops, the worst of which are not harvested until perhaps two years after suitable climatic conditions have returned. For the same physiological reasons the application of fertilisers produces no immediate effect upon the crop, but does produce a prolonged subsequent effect which may reach its climax two years or even longer after the application. For these reasons, the use of fertilisers and the practice of

irrigation are not convenient subjects for class experiments. Since experiments of this kind must run over a series of years, the class is dependent, for its understanding of such subjects, on instruction in class and on the inspection of work in the field. Growth, in distinction to the yield of nuts, shows the effect of good or bad treatment or conditions with reasonable promptness. It is possible from the growth of the tree in one season to forecast with a high measure of probability the yield from 1½ to 3 years ahead. Familiarity with the growth of the coconut is therefore of the utmost importance as furnishing an easy and reliable method of determining the condition of a grove and its future productivity. The students in this class have previously had in their course in plant physiology the most thorough drill in determining the rate of growth of plants in general, and of their parts, and in this course are merely given particularly emphatic drill on the growth of the coconut. This drill is expected to be so thorough that no one of these students can determine, from a day's observation in a coconut grove, whether or not the trees are as thrifty as they should be, and in this way, to determine what the crop may be expected to be two years ahead, and whether or not there should be a change in the treatment the trees are receiving.

On the practical side, the student is expected to determine standards of efficiency in the ordinary operations required on a coconut plantation. The value of such standards can be illustrated by an example. From the work of one of these classes several years ago, it was concluded that a reasonably efficient labourer, during the usual working day, should be able to clean the ground for a meter around sixty trees, and to do this work thoroughly. On a certain coconut plantation, labour was being hired by the day to keep a grove clean, certain labourers being used for exactly such work as had been standardized at the college. The labourers seemed to be busy, and there was no visible reason to complain of their inefficiency ; but on an average, they were cleaning only a little over fifteen trees a day. The manager was informed as to the standard which had been decided upon at the college, and proceeded to test it. Their objections lasted only one day, and the men then expressed their willingness to do the work under contract at the rate of sixty trees for a day's wage. As a matter of fact, the college student is less efficient than a good labourer, when it is a question of prolonged work. In spite of the fact that it is far above ordinary present plantation efficiency, our standard is still lower than it should be. There has been a vast amount of attention to standardization of efficiency in factory and office work, and altogether too little attention to the standardization of efficiency in farm operations.

Copra manufacture is one of the foremost industries of the Philippine Islands. Of all the industries of these islands, it can safely be said to be the worst in its practice. The farmers of the islands have been given many cubic meters of advice on the subject, and this has had almost no practical effect.—Philippine Agriculturist and Forester.

MANURIAL EXPERIMENTS ON COCONUTS.

JOSEPH DE VERTEUIL, F.C.S.

This report deals with the second year's results of the manurial experiments on coconuts, under the control of the Board of Agriculture and is in continuation of the report for 1911-12 (Bulletin, Department of Agriculture, XI. 1912. pp. 179-184).

The dry season of 1912 was very severe and although the number of nuts picked from the plots on the Morvant estate, Laventille, and the King's Bay estate, Tobago, does not show a marked decrease, it will be observed that a smaller proportion of " selects" has been obtained than during the previous

year. On the Beaulieu estate at Cedros, the crop has been considerably affected and the proportion of selects has been reduced by nearly 50 per cent.

Mention was made in the previous report that the yield for the first year may be considered as a "natural yield" for each plot, owing to the fact that the manures had only been applied shortly before. This year's yield may therefore be compared with that obtained from the corresponding plots last year, but no conclusions should be drawn from the results of a single year.

The figures obtained are given in Tables I. to V. for each estate respectively.

MORVANT ESTATE—LAVENTILLE.

The second application of manures was made in May 1912.

Rainfall { 1911-12 39·12 in. / 1912-13 41·27 in.

TABLE I. Manurial Experiments, Morvant Estate.

TREES ABOUT 26 YEARS OLD.

Plot.	No. of Bearing Trees.	Manures applied per Tree.	Crop July 1st to June 30th.	Average No. of Nuts Picked per Tree.
1	68	4 lb. Lime 4 „ Kainit	1911-12 1912-13	20·3 36·7
2	69	6 lb. Basic slag 1 „ Sulphate of potash	1911-12 1912-13	38·9 47·5
3	70	Control—No manure	1911-12 1912-13	40·7 53·1
4	70	4 lb. Basic slag 2 „ Nitrate of Soda	1911-12 1912-13	35·1 47·0
5	70	2 lb. Calcium cyanamide 2 „ Sulphate of potash	1911-12 1912-13	43·8 58·3
6	70	Control—No manure	1911-12 1912-13	25·9 39·4
7	70	2 lb. Bone meal 1 „ Sulph. of potash 150 „ Pen manure	1911-12 1912-13	41·0 55·7
8	67	2 lb. Superphos. of lime 1 „ Sulph. of potash 150 „ Pen manure	1911-12 1912-13	31·1 37·2

All the plots have given an increased yield over the previous year, but the increase from plots 1, 5 and 7 is greater than that of the control plots. From a pecuniary point of view, plot 1 alone has given a profit.

BEAULIEU ESTATE—CEDROS

These experiments are being conducted in three series, A, B and C, as shown in Tables II. to IV. The average results obtained for the three series is given in Table V.

The manures were applied in April, 1912.

Rainfall { 1911-1912 39·84 in. / 1912-1913 55·76 in.

TABLE II.—Manurial Experiments Beaulieu Estate, Cedros.

Series A.

Trees 31 to 36 Years Old.

Plot.	No. of bearing trees.	Manures applied per tree.	Crop, July 1, to June 30	Average number of Nuts picked per tree.
1	15	4 lb. Lime 4 „ Kainit	1911-12 1912-13	135·9 73·5
2	17	6 lb. Basic slag 1 „ Sulphate of potash	1911-12 1912-13	107·4 54·9
3	12	Control—no manure	1911-12 1912-13	120·8 76·2
4	14	4 lb. Basic slag 2 „ Nitrate of soda	1911-12 1912-13	135·1 101·8
5	15	2 lb. Calcium cyanamide 2 „ Sulphate of potash	1911-12 1912-13	138·9 82·4
6	14	Control—no manure	1911-12 1912-13	146·8 81·8
7	15	2 lb. Bone meal 1 „ Sulphate of Ammonia 150 Pen manure	1911-12 1912-13	126·4 70·1
8	15	2 lb. Superphos. of lime 1 „ Sulphate of potash 150 „ Pen manure	1911-12 1912-13	125·3 85·5

TABLE III.—Manurial Experiments, Beaulieu Estate, Cedros—Series B.

TREES 31 TO 36 YEARS OLD.

Plot.	No. of bearing trees.	Manures applied per tree.	Crop July 1, to June 30.	Average No. of nuts picked per tree.
1	19	4 lb. Lime 4 „ Kainit	1911-12 1912-13	83·0 76·2
2	26	6 lb. Basic slag 1 „ Sulphate of potash	1911-12 1912-13	70·0 55·3
3	29	Control—No Manure	1911-12 1912-13	50·1 34·4
4	25	4 lb. Basic slag 2 „ Nitrate of soda	1911-12 1912-13	54·9 46·8
5	25	2 lb. Calcium cyanamide 2 „ Sulphate of potash	1911-12 1912-13	61·7 45·5
6	22	Control—No manure	1911-12 1912-13	65·2 44·9
7	24	2 lb. Bone meal 1 „ Sulphate of ammonia 150 „ Pen manure	1911-12 1912-13	56·1 42·4
8	26	2 lb. Superphosphate of lime 1 „ Sulphate of potash 150 „ Pen manure	1911-12 1912-13	57·3 59·9

TABLE IV.—Manurial Experiments.—Beaulieu Estate, Cedros.—Series C.

TREES 31 TO 36 YEARS OLD.

Plot.	No. of bearing trees.	Manures applied per tree.	Crop July 1, to June 30.	Average No. of nuts picked per tree.
1	26	4 lb. Lime 4 „ Kainit	1911-12 1912-13	55·8 44·5
2	24	6 lb. Basic slag 1 „ Sulphate of potash	1911-12 1912-13	82·4 50·4
3	25	Control—No manure	1911-12 1912-13	59·0 50·6
4	24	4 lb. Basic slag 2 „ Nitrate of Soda	1911-12 1912-13	63·9 58·0
5	16	2 lb. Calcium cyanamide 2 „ Sulphate of potash	1911-12 1912-13	103·3 76·4
6	18	Control—No manure	1911-12 1912-13	77·6 57·2
7	18	2 lb. Bone meal 1 „ Sulphate of ammonia 150 „ Pen manure	1911-12 1912-13	101·9 67·6
8	19	2 lb. Superphosphate of lime 1 „ Sulphate of potash 150 „ Pen manure	1911-12 1912-13	98·7 59·0

KING'S BAY ESTATE, TOBAGO.

The second application of manures was made in March, 1912.

Rainfall. { 1911-12 66·71 in. / 1912-13 64·57 in.

TABLE V.—Manurial Experiments, King's Bay Estate.

TREES 21 TO 26 YEARS OLD.

Plot.	No. of Bearing Trees.	Manures applied per Tree.	Crop : July 1, to June 30.	Average Number of Nuts picked per tree.
1	46	4 lb. Lime 4 „ Kainit	1911-12 1912-13	74·4 83·8
2	66	6 lb. Basic slag 1 „ Sulphate of potash	1911-12 1912-13	56·2 71·7
3	56	Control—No manure	1911-12 1912-13	60·3 63·5
4	82	4 lb. Basic slag 2 „ Nitrate of soda	1911-12 1912-13	51·1 58·5
5	70	2 lb. Calcium cyanamide 2 „ Sulphate of potash	1911-12 1912-13	67·6 79·6
6	80	Control—No manure	1911-12 1912-13	58·4 56·2
7	65	2 lb. Bone meal 1 „ Sulphate of ammonia	1911-12 1912-13	54·1 72·7
8	76	2 lb. Superphosphate of Lime 1 „ Sulphate of potash	1911-12 1912-13	60·4 77·6

With the exception of control plot 6, there has been a slight increase in the number of nuts obtained per tree from all the plots as compared with the previous twelve months. There has been a decrease in the proportion of selects varying from 0·3 to 10·8 per cent. On this estate all the manured plots have given a larger increase than the average of the control plots and the pecuniary results are satisfactory.—BULLETIN No. 77, DEPARTMENT OF AGRICULTURE TRINIDAD AND TOBAGO.

CACAO.

SOME NOTES ON THE MANURIAL EXPERIMENTS OF CACAO.

W. C. JARDINE.

The results so far show the difficulty—almost the impossibility—of drawing definite conclusions from manurial experiments made upon such heterogenous cultivation as that of cacao in Trinidad, at least until an exhaustive record covering not less than five years is procurable. I have come to the conclusion that a comprehensive digest of the inferences it would be safe to draw from the results of such experiments at the end of that time would be one of the most difficult tasks any man could set himself; nevertheless, we will certainly be faced with such a necessity, and I do not envy to him to whom the task may fall. I do not say this from any desire to discourage the work being done, but speak rather from the position of the patient who eagerly looks to his doctor to discover a cure for his troubles, and to whom the whole position looks rather vague in its present unripe state.

As an example of what I mean, if we follow the history of one particular treatment or combination of manure right through the series, we are faced with the most contradictory and disappointing results, which may be shortly expressed as—good,—no good,—fair,—not worth while,—and so on. Plot No. 1. for example shows that the combination of basic slag and sulphate of potash has apparently produced the following effect per tree over the previous year. On Santa Marta estate an increase of about 6 pods; on Esperanza a decrease of 4 pods; on New Grant an increase of ·34 pods; on Santa Teresa a decrease of 2 pods; on La Compensacion an increase of 6 pods; on Santa Isabella an increase of 6·5 pods; and on Soconusco a decrease of ·2 pods.

Here we have the very gamut of inconsistency, which if viewed in the light given by the corresponding control plots, appears to become confusion worse confounded, and it is abundantly evident that it would be useless at this stage to draw any but the most preliminary conclusions.

If we lump all the plots together and reduce the figures to averages we will find—taking the same example—that 931 trees (being parts of seven different estates in seven different districts), produced a net increase over the previous year of 1,544 pods = 1·66 pods per tree, and deducting the average increase per tree on 19 control plots = ·82 pods we find this treatment giving us an average net increase of ·84 pods per tree, or 782 pods at a cost of about $32·00; a result which need cost the planter no further study could this result be considered as at all conclusive.

There can be no possible doubt that the individual bearing capacities of the trees making up a plot exert a disconcerting influence on the diagnosis of results taken separately; but this is unavoidable, being characteristic of

Trinidad cultivation generally, and so far as the effect of the manurial treatment is concerned, will eventually be reduced to a minimum as time passes and records accrue.

We may, however, get a few very interesting glimmerings or forecasts of what will probably be established among other things at the end of a sufficient period, not the least important of which is the danger of applying caustic lime to the soil in a climate where bacterial action continues almost undiminished throughout the year, and the land is exposed to heavy inundations during the rainy season. The free use of lime has become considerable in Trinidad of late years, caused no doubt by its rapid effect upon the yield ; but it should be realised that its action is in reality nothing but a rapid consumption of your capital in the form of organic fertility,—more particularly on light unmanured soils,—which will as certainly be followed by years of reduced yield. A glance at the plots which were limed the previous year will emphasise this.

An intensely interesting review (published in 1912) of the world famous manurial experiments at Rothamsted (which have been running now for over sixty years) by the former Director A D. Hall, M.A., F.R.S., provides such valuable information that, although the experiments here and at Rothamsted are not completely analogous, many of the general conclusions undoubtedly apply, some of the more apposite of which are well worth quoting.

1. It is established that in the case of wheat—"a ten-year period is not sufficient to eliminate the fluctuations in yield due to seasons."

2. That the continuous growth of some crops,—notably wheat,—does not unfit the land for that crop provided a suitable fertiliser supply is maintained. "If there is any toxic effect . . . . this effect . . . . . in the case of wheat . . . . . so small as to be negligible."

3. The reverse is the case with barley, while with clover and some other crops the impossibility of maintaining them consecutively on the same soil is well known, and while the present state of our knowledge does not justify us in ascribing this fact to toxins produced by these crops, the probability of such being the case is markedly allowed for.

4. That on two plots abandoned for over twenty years, one gained nitrogen at the rate of 92 lb. per acre per annum, the other 41 lb. per acre per annum, the greater amount of the former being due to the soil having three per cent. carbonate of lime, enabling free growth of leguminous plants, and the better action of the free bacteria in the soil which fix atmospheric nitrogen,—the Azotobacter.

5. "The higher the level of production the greater the waste, and in consequence, the additions of fertiliser must be doubly increased to maintain the balance." This is partly due to the high pressure (so to speak) at which the fertility mill is working (reminding one of the disproportionate waste of coal required to produce a comparatively small increase of energy over a certain limit); and to the fact that certain groups of bacteria denitrify the organic matter, liberating free nitrogen.

6. That the ploughing or tilling of the soil brings about a destruction of the organic nitrogen, while leaving it undisturbed under vegetation causes the increase of the same.

7. That rain—at Rothamsted,—adds to the soil 4 lb. of nitrogen per acre per annum.

8. That plants short of potash will be specially liable to attacks of fungoid diseases

Most of these facts have been recognised by agricultural science for a considerable time now, but they are very forcibly corroborated by the long scientific evidence of the Rothamsted experiments, and their significance in the same direction here will surely not be lost.

I have not attempted to go exhaustively into every combination, and perhaps the example I have chosen is the least consistent, but it will serve to show the difficulties which beset this line of investigation in Trinidad, and to emphasise MR. DE VERTEUIL'S remarks as to the necessity of having the previous history of the plots. I think it is worth considering whether the manurial scheme should not be improved upon, and a wider scope given in the periods of application, while the yields of the plots for as many years previous to the experiments as possible should appear. Analyses of the soils of the plots before, and at intervals of several years after treatment would throw more light on the results to come.

The work which the Board is doing under this head is destined to be of inestimable value to the cacao industry in the future, and is one which more than deserves all the time and trouble which can be expended upon it.—BULLETIN No. 78, DEPARTMENT OF AGRICULTURE, TRINIDAD AND TOBAGO.

CACAO PRUNING.

Pruning in the West Indies is attended with the greatest amount of care, and is performed for the purpose of producing a vigorous tree by the removal of all useless wood, and of encouraging fruiting branches to increase their production. In order to do the latter it is essential to remove any superfluous number of primary branches, three or four being considered sufficient for one tree. A similar regulation of growth is required with regard to the secondary and tertiary branches. In addition to this, care is given to retain the correct balance for the tree, and, when cutting out branches to avoid making jagged cuts or slashes. The West African native does not prune with these objects in view, but employs a cutclass or machete to cut out those branches which seem to be giving too much shade or which have become interlaced, regardless of their value to the tree or of the wounds inflicted in the operation. Efforts have been made to teach pruning at the Botanic Stations, but the demonstrations have not been largely attended, and a great deal of damage continues to be done through ignorance of the objects and efforts of pruning. Many of the older plantations, owing to bad treatment and too close planting, are yielding an annually diminishing crop, but new ones are springing up in increasing numbers each year, which is an obvious indication that the industry is proving a profitable one.—BULLETIN No. 79, TRINIDAD AND TOBAGO DEPT. OF AGRIC.

CULTIVATION OF CACAO IN TRINIDAD AND THE GOLD COAST.

W. G. FREEMAN.

A reply to an article in the Philippine Agricultural Review attributing the recent decline in the exports of Cacao from Trinidad to bad cultural practices, overshading of trees and severe fungus disease.

The writer points out that this decline corresponds to seasons of abnormally low rainfall and gives figures showing a considerable improvement in the production of cacao during 1913 corresponding to an improvement in the climatic conditions. Reference is also made to reports of the Gold Coast Department of Agriculture showing that the remarkable increase in the exports of cacao from West Africa is due to the natural advantages of suitable areas and cheap labour ; rather than to the application of scientific horticultural methods.—Monthly Bulletin.

MANURING OF CACAO IN DOMINICA.

Mr. H. A. Tempany, Superintendent of Agriculture in the Leeward Islands, includes the following interesting summary on the manuring of Cacao in the Report of the Agricultural Department, Dominica, for 1912-13 :—

Manurial experiments with cacao have been systematically conducted both at the Botanic Gardens and in country districts in Dominica during the past eleven years. It is believed that the accumulated results now enable sound deductions to be drawn regarding the manuring of cacao under these conditions.

The principal fact which stands out is the value of natural organic manures either in the liberal application of pen manures or compost.

There does not appear to be any room for doubt that methods of manuring based on this principle are those likely to give satisfactory results under the conditions in question.

It may again be pointed out, however, that good results can only be expected to accrue from this or any other form of manuring if due attention is also paid to the requirements of the trees in other directions such as general care, pruning, sanitation, and on heavy soils, drainage ; it is further to be remembered that it is not all localities in Dominica which are suitable for cacao cultivation.

Having regard to these points it seems to be the soundest policy for cacao growers to endeavour to raise large quantities of organic manure for application to their orchards.

Difficulties of transport are frequently urged as an argument against the utilisation of the abundant supplies of material for mulching available in the forests of Dominica, the view may however be expressed that if full use were made of readily available material and if this were systematically combined with the utilisation of such stock as exist on the estate and the raising of leguminous and other crops as additional material for mulching, the problem would not be far from being solved in many cases.

When sufficient organic manure is not available to supply a complete manuring it should be supplemented by artificial manures which should always contain nitrogen and phosphate. Nitrogen is best given in some form in which the constituent becomes slowly available, such as tankage, dried blood, or cotton seed meal. Rapidly acting forms of nitrogenous manure such as nitrate of soda and sulphate of ammonia and nitrate of lime are of more especial value when it is desired to give a strong stimulant to trees that are in an unsatisfactory condition.

Calcium cyanamide or nitrolim continues to attract a certain amount of attention as a possible nitrogenous manure in cacao cultivation and although no very definite information is available concerning this manure the fact that its nitrogen becomes available with relative slowness and that it possesses a high content of lime indicates that it may be of value in cacao cultivation under these conditions.

Basic slag appears to be the most suitable form in which to apply phosphoric acid largely by reason of the considerable excess of lime which it contains.

There is no separate evidence available to show the effects of potash but the majority of Dominica soils are well supplied with this constituent and there is nothing to lead us to believe that applications are likely to be of value.

It is a characteristic feature of Dominica soils that they are deficient in lime, and although trials of this substance have not been included in the experiments so far conducted there is ample internal and collateral evidence to show that applications of lime are likely to be of marked benefit if given in conjunction with suitable manurial applications.—Bull. No. 79, Trinidad and Tobago Dept. of Agriculture.

CEYLON TIMBER.

According to the Administration Report of Mr. F. J. S. Turner, the acting Conservator of Forests, 475 ebony logs weighing $160\frac{1}{3}$ tons were sold during 1913 for Rs.33,397·34, or an average of Rs. 208·40 per ton. This cost Rs. 45·02 per ton to place in the depot. Both the cost and sale price are considerably better than in 1912. The highest price realized in 1913 was Rs. 600 per ton, which is identical with the highest price obtained in 1912.

Satinwood.—327 logs containing $10{,}252\frac{1}{2}$ cubic feet were sold for Rs. 66,678·08 in 1913, which gives an average of Rs. 6·50 per cubic foot. It cost Re. 1·22 to place the average cubic foot in the depot. The quantity sold, the total takings, and the average price all exceed those of 1912, but the rate of delivery was 3 cents higher per cubic foot in 1913 than in 1912. This increase in cost of delivery points to the working of less accessible areas, and is a very reasonable increase. The best price realized in 1913 was Rs. 18·80 per cubic foot, and this is Rs. 2·80 better than the best of 1912.

RICE.

THE PRINCIPLES OF PADDY MANURING.

W. H. HARRISON.

(*Continued from page 295*).

POTASH AND PHOSPHATE.

With regard to green-manures, it must be borne in mind that the potash and phosphoric acid they contain is obtained from the soil on which they are grown and in consequence no enrichment of the land in this respect is obtained. All that happens is that the potash and phosphoric acid present in the soil is taken up by the green manure crops and again returned to the land, but in a condition to be readily absorbed by the main crop which follows. Now, as the practice of green manuring leads to heavier paddy crops it follows that ultimately more potash and phosphoric acid is removed from the soil than would otherwise be the case and the land in consequence will all the sooner be impoverished with regard to these two manurial ingredients. Provision must therefore be made to supply these ingredients to the land in the course of time, and this is best done by occasionally dressing the soil with such manures as "super" and bone-meal which are very rich in phosphoric acid and more occasionally still with wood-ashes, sulphate of potash, etc., manures which are rich in potash. The point to be remembered is this, that green-manures are not complete manures as they bring only nitrogen and humus to the soil.

GREEN LEAF MANURES.

Green-leaf manures, i.e., leaf and branches cut off from plants growing on waste ground or forests and puddled into the soil have practically the same effect as green-manure crops, but they differ from the latter in so much as they supply potash and phosphoric acid in addition to nitrogen. They are complete manures and from this point of view are to be preferred to green-manure crops grown on the land itself supplemented by a comparative small annual dressing of superphosphate or bone-meal.

Comparative tests with green-manures have been carried out at Coimbatore, with the result that green-leaf manure gave a yield of 4,490 lb. of paddy and 5,811 lb. of straw per acre, whereas, the same weight of daincha (grown on the ground) gave 4,200 lb. paddy and 4,400 lb. straw. The difference between the yields of paddy in the two cases is not great, considering the large yields obtained, but such as it is it is due to the extra potash and phosphoric acid brought to the soil with the green leaves, for when "super" is used in conjunction with the green-manure the yields obtained often exceed that obtained when green-leaf manure is used. Compared with the yields from plots receiving no manure which gave only, 3,392 lb. of paddy and 3,124 lb. of straw, the efficiency of green manures and green leaf manures is undoubted.

A FINANCIAL COMPARISON.

Poonacs and fish manures are also bulky organic manures which can be utilized with advantage where they are obtainable at a cheap rate. They contain a much larger proportion of nitrogen and other manurial ingredients than green manures and, consequently, can be used in much less quantity. Thus in an experiment carried out on the Coimbatore Farm to compare the relative values of these bulky organic manures 4,000 lb. of green leaves yielded a profit of Rs. 120 per acre, 4,000 lb. of wild indigo Rs. 98, 400 lb. of white castor poonac Rs. 109, 500 lb. of black castor poonac, Rs. 104, and 560 lb. of fish manure gave Rs. 114.

Poonacs are complete manures, and there is generally little necessity to use any other manure in conjunction with them unless it is superior bone-meal to increase the proportion of phosphoric acid put on the land.

This mixture is generally very effective in increasing the yield of paddy, and the cost of the "super" needed for the purpose is comparatively small. On the other hand, fish manure is not a complete manure as it is practically devoid of potash and in consequence wherever the soil is deficient in that ingredient a mixture of sulphate of potash or wood ashes with fish manure can be used with advantage. The use of this mixture, however, should only be attempted after a small trial has given successful results, as not only is the potash expensive (thus reducing the profits) but unless there is actual need for it the tendency is to reduce the yields given when compared to fish manure alone. Thus the use of 560 lb. of fish manure and 56 lb. of sulphate of potash resulted in a net profit of only Rs. 82 as against a profit of Rs. 114 with fish manure alone. On the other hand, with one experiment in the Kistna delta, potash gave an actual increase in the profit obtained.

Manures obtained from bones, the chief of which are bone-meal and bone superphosphate, can under certain circumstances be used with advantage in manuring paddy. Bone meal is exceedingly rich in phosphoric acid, and, as a rule, contains a fair proportion of nitrogen; and at the same time it undergoes rapid decomposition in paddy soil and its manurial ingredients are thus quickly made available for plant food. To a certain extent, therefore, it conforms to the principles laid down on the first part of this article, but the amount of humus it can yield is exceedingly small and the best effects are produced when it is used in conjunction with a manure containing large quantities of organic matter, particularly with green-manures. In this case, the substances produced by the decomposition of the green manure assist the solution of the phosphoric acid of the bones and thus make the latter much more available for the plant than would otherwise be the case. The same strictures which apply to the use of potash manures with fish manures apply also in this case. Unless the soil is very deficient in potash, recourse should not be had to this ingredient owing to its tendency to reduce the yields and profits. Thus, at Coimbatore 500 lb. bone-meal yielded a net profit of Rs. 112 per acre, whereas, the same quantity to which 56 lb. of potassium sulphate were added only gave Rs. 79.

SUPERPHOSPHATE.

Bone superphosphate is obtained by treating bones with sulphuric acid, by which the phosphoric acid is made soluble and when added to a soil is at once available as a plant food.

This manure is therefore a "quick-acting manure" and its effect is best seen when given in the form of dressings to crops already in the ground. Usually it contains some nitrogen in addition to the phosphoric acid but its value is mainly dependent upon the amount of the latter ingredient present and consequently with soils poor in humus such as are general in Southern India, it is best used in conjunction with the bulky organic manures. Thus, at Coimbatore, land manured solely with a green manure crop grown on the land itself gave 2,814 lb. of paddy and 2,691 lb. of straw, whereas similar lands manured with the same green-manure crop plus 112 lb. of superphosphate gave 3,733 lb. of paddy and 4,043 lb. of straw. The conclusion in this case is obvious, especially when it is noted that the large increase was due to an amount of "super," valued at less than Rs. 3.

It must also be pointed out that the use of comparatively large dressings of super does not yield a commensurable increase in the crop obtained, so that, except under exceptionable circumstances, a dressing of 112 lb. of super to the acre is the maximum necessary.

The Mineral and artificial manures.—These manures which include superphosphate, ammonium sulphate and saltpetre, are (with the exception of the last) not of great importance to the ryot owing to their comparative scarcity and high price. Saltpetre is produced locally in large quantities and as it contains both potash and nitrogen it is under certain conditions of cultivation a good manure, but the nitrogen being present in the form of nitrate, it is, as was shown at an earlier stage, not suited for paddy manuring.

AMMONIUM SULPHATE.

Ammonium sulphate is only produced in India to a very limited extent and is mainly imported from Europe, so that although it is a quick-acting manure and quite suited to paddy cultivation, the cost of the nitrogen is so great that at present it may be left out of account by the ryot.

Superphosphate is prepared from mineral phosphates in exactly the same way that bone superphosphate is prepared from bones and consequently almost all that has been written regarding the latter applies to this substance also. It must, however, be remembered that unlike bone super it contains no nitrogen. Another phosphatic manure is basic slag and probably with a development of the steel trade in this country, it may become readily accessible to the cultivator. At present, however, it may be left out of account.

Lately, two artificial manures have been introduced in Southern India, namely, calcium nitrate and cyanamide and it is probable that in the near future they will be manufactured in this country. Of the two, so far as paddy cultivation is concerned, calcium nitrate is of little use, but cyanamide may possibly find an application as it yields ammonia in the soil and in consequence could be used to enrich the nitrogen content of low grade poonacs, etc. Experiments are now being carried out with this substance at Coimbatore.

THE JUDICIOUS COMPROMISE.

All of these artificial manures, it must be pointed out, do not fulfil the first condition laid down with regard to paddy manuring, i.e., to supply organic matter to the soil; and consequently, although they can be used

either alone or in suitable admixture with one another, the best results are obtained when they are used in conjunction with bulky organic manures. An exception may, however, often be made in the case of superphosphates, for when the soil is pure in phosphoric acid, a dressing of the substance has often yielded remarkably good crops, but even here it will be necessary sooner or later to supply organic matter if the enhanced rate of cropping is to be maintained.

In concluding this section it must be stated that many of the yields which have been quoted were not obtained the first year after applying the various manures. In reality the yields obtained have gradually increased with each annual application of manure, so that a permanent enrichment of the soil has taken place. Thus, when green-manure was first applied to a plot of paddy land on the Central Farm, a yield of only 2,400 lb. of paddy per acre was obtained, but the next season yielded 3,500 lb. and now after being annually manured for four years the yield is 3,900 lb. Most of the other experimental plots show the same increasing outturn and in one case the yield now obtained is 4,500 lb. This result is most important as showing the possibility of producing a greatly increased fertility in paddy soils, but to obtain such results careful and systematic manuring is required. Spasmodic manuring at intervals of a series of seasons cannot bring this about and will only lead to a comparatively insignificant increase in the average fertility of the soil.—Journal of the Board of Agriculture, British Guiana.

UPLAND RICE IN THE PHILIPPINES.

MARCELO CRISOSTOMO Y SALAMAT.

Rice is now more or less extensively cultivated in nearly all tropical and semi-tropical countries and constitutes the staple food of half of the human race. It was reported during the year 1911 that 1,043,757 hectares of land in the Philippine Islands were used for growing rice, producing 882,794·13 metric tons of raw rice (palay); probably approximately two-thirds of this area was occupied by upland varieties.

The cultivation of upland rice in the Philippines is mainly handled by primitive methods. Its culture in the heavier producing section does not at present form a part of the system of diversified farming which is essential for the up-building of the soil; nor does any single crop system furnish the mixed diet which is necessary for the proper development of a strong and healthy race of people. While the method of culture at present is rather primitive, new ideas are being taken up to some extent.

The depth of surface soil for rice need not be very great, 7 or 8 inches being enough. The temperature required by rice is about 14° C. for germination, and about 25° during the growing period.

The degree of improvement of rice cultivation throughout these Islands will certainly measure the growing intelligence of the farmers, especially the rice growers, whose prosperity probably depends more upon the condition of the rice crop than upon any other thing.

The present studies were carried out with the object of making a careful comparison of certain varieties of upland rice as to their gross morphological characters, their behaviour under cultivation, their yield, and value. Some of the characters examined were:—

1. Average daily growth.
2. Number of days required for maturity.
3. Amount of stooling.
4. Average number of grains in head.
5. Colour, size, and shape of the grain.
6. Characteristics of the grain that affect its value as food.
7. Comparison of yields.

These points will be taken up in the order in which they are listed here.

Twenty-four upland rice varieties were sown broadcast May 31, 1912, in plots ten meters square, and covered with soil by harrowing.

The field where the twenty-four varieties were grown had been previously planted with legumes and finally with rice; but, owing to the unfavourable weather, the last crop did not reach maturity.

The total rainfall in centimeters for each month was as follows:—

April, 0·33; May, 15·44; June, 8·12; July, 29·50; August, 46·00; September, 31·88; October, 4·09; November, 21·37; December, 7·07.

The rainfall for June was too scant and the plants suffered from drought three weeks after sowing. The growth was therefore abnormal for a few weeks, but a gradual increased rainfall later enabled the plants to continue their growth vigorously. It is important in the cultivation of rice to determine the quantity of water that each variety requires and this knowledge is of fundamental value to the rice grower.

From measurements taken during the earlier part of the life of the plants used in this test, it was found that the average daily growth of the quickest growing leaf of the most quickly growing variety was about 25 mm.; and of another good one, 23 mm. The slowest growing grew 14 mm. and the second slowest 16 mm. each day (measured by increase of length of the quickest growing leaf).

These growth measurements suggest that the different varieties might perhaps be identical in our plots by knowing only their different growth records provided they be grown under the same conditions.

The time needed to reach maturity differs so widely in different varieties, that we can group them according to the number of days which they need to reach maturity as follows:—

Early varieties	...	100 to 150 days
Medium varieties	...	150 to 180 days
Late varieties	...	more than 180.

Of course it is impossible to sharply distinguish varieties of rice according to time of maturity, especially where climatic conditions vary considerably. In districts where soil and climate are nearly uniform such a grouping may be very useful. The varieties that mature quickly are of course preferable, because they are harvested in a shorter time, and require shorter periods of care.

The two earliest varieties that were harvested are Dinaliquit from Calamba, and Tiniaong from Los Baños. The former took 105 days from sowing to maturity and the latter 127 days. The two latest varieties as determined from this test are Malagkit kinabae from Malolos, Province of Bulacan, and Minalet from the same place. The former took 180 days from sowing to maturity and the latter 194 days. Two medium period varieties are Ipotibon from Malolos, Province of Bulacan (177 days) and Pinursigui from Malolos(179 days).

The varieties that produce the most stems per stool are not necessarily those that give the greatest yields; thus the varieties Pauni and Binuhangin that have about the same number of stems per stool gave yields of 44 and 27 cavans per hectare respectively.

The upland rices can be classified as glutinous or non-glutinous. The distinction has been noticed from ancient times. There are no remarkable differences in the morphological characters between these groups, but glutinous rices have generally more tender leaves than non-glutinous rices, so that their straw is more valuable for many purposes. The principal difference is in the character of their grains. Those of the glutinous rices when fully ripe and well dried become quite opaque and have a silky white colour; but when steamed they become much more transparent and show more viscosity than those of the non-glutinous rices.

It has been found that starch of some rices gives a reddish-brown colour when zinc chloride in iodine is added to it, and that such a reaction always appears with the starch of glutinous rice. Iodine colours the starch of glutinous rice from yellowish to brown, while it turns that of non-glutinous rice violet. This would seem to indicate that glutinous rice contains dextrine replacing starch. It has been determined that a part of the starch is replaced by sugar and dextrine, and that the endosperm of the glutinous rices contains only a small percentage of common starch.

Four varieties were analysed for nitrogen. The results are as follows :—

	Nitrogen.	Proteid. (N × 6·25)
Glutinous :		
Malagkit tinalaksan	... 1·26 per cent.	7·87 per cent.
Malagkit binalintin	... 1·116 ,,	6·97 ,,
Non-glutinous :		
Dinalaga	... 1·06 per cent.	6·63 per cent.
Kalibong pula	... 1·00 ,,	6·25 ,,

The grains of different varieties vary in length and thickness. According to the length of the unhulled grains we can classify them as long, medium or short.

The grains of some rices are extraordinarily long, their length exceeding three times their breadth; these will be called slender grains. Those grains whose length is between two and three times their width will be called inter-mediate grains. Those whose length is less than twice their width will be called broad grains.

The rice grains in the twenty-four varieties grown were grouped according to the shape and size of the hulled and unhulled grains.

The most prevalent colour of rice is white, which varies from a chalky white as usually seen in glutinous rices to the transparent waxy white that is common in non-glutinous varieties. Sometimes there is a pale yellow or greyish tint. A brownish red colour often changes to purple in the glutinous rices. A black colour is not rare in glutinous rices. The colour of the rice grain is found in the pericarp of the grain, and may be removed by polishing.

The rice grains have as a rule certain longitudinal depressed lines, and these portions of the surface, in the coloured rices, may still retain some colour after polishing, which often gives an ugly appearance to the finished product. To get rid of this colour costs much time and labour.

Newly harvested rice possesses a very sweet odour, but this disappears in storage. The most highly scented varieties are: Dinalaga, Binicol, Binuhangin, Kalibong pula, and Malagkit tinalaksan.

The length of unhulled rice grains varies from 6·00 mm. to 9·00 mm. The breadth of the grains varies from 2·50 to 4·00 mm. and thickness from 1·50 to 2·70 mm.

Experience is needed in cooking rice, because the quantity of water used varies according to the variety. Some require only a small amount of water, as in the case of Pinursigui and Tiniaong.

The following varieties which are soft when cooked, generally need more water: Dinaliquit, Dinalaga, Binicol, Kinagaykay, Binuhangin, Kalibong pula and Macan.

The amount of crop given by the different varieties always varies, even when they are broadcasted with the same amount of seed in the same sized areas of land and cared for equally. The two plots that gave the best crops were:—

Pauni	...	...	44 cavanes
Malagkit	...	...	42 do.

The two poorest yields were given by:—

Kinagaykay	...	...	17 cavanes
Pinursigui	...	...	22 do.

SUMMARY.

The preceding paper gives a statement of the yield of some Philippine rice varieties as grown on the College Farm; also the average dimensions and general characteristics of the grain of different varieties; and some measurements of the rate of growth of individual plants.

The writer is indebted to PROFESSOR BAKER and Assistant PROFESSOR CUZNER for help in planning the experiment.—PHILIPPINE AGRICULTURIST AND FORESTER.

COTTON.

SOME FACTORS CONTROLLING THE GROWTH OF COTTON.

H. T. FERRAR AT THE BRITISH ASSOCIATION MEETING, AUSTRALIA.

Among the main factors which control the cultivation of cotton on a commercial basis are:—(1) Temperature, (2) water supply, (3) soil, (4) labour.

1. The cotton plant is commonly found in those parts of the world which lie within thirty degrees of the Equator, but finds its best development in what may be described as sub-tropical climatological regions. In Egypt the air temperatures which rule at sowing time are in the neighbourhood of 65° F.; as the plants attain maturity the temperatures gradually rise to values of 82° F. and 83 ° F. and fall some 9° or 10° during harvest.

2. The water requirements of the crop are equivalent to about 46 inches of rainfall, which in Egypt is met by irrigation from perennial canals. The water factor naturally depends upon environment.

3. The volume (depth) of soil available to the roots of the cotton plant is of more importance than its texture or its chemical composition, provided always that the soil contains sufficient available plant foods. In Egypt cotton is grown profitably on a soil, which in one extreme case is an almost pure sand, and in the other extreme an unctuous clay.

4. The profits derived from the cultivation of cotton naturally depend upon the cost of agriculture. Where the price of labour is high better returns are obtained by cultivating the more valuable types of cotton. The higher grade Egyptian cottons grow best in the Delta, while warmer Middle Egypt supplies a cotton (Ashmuni) whose fibre is of medium value only.

The East Coast of Australia would seem to provide the requisite temperatures and rainfall necessary for cotton cultivation, but widespread experiment is necessary if it is desired to prove what areas provide suitable conditions and what is the margin of profit of the husbandman.—Journal of Agriculture, Victoria.

COTTON PLANTING.

The proper time for planting is after the first spring rains. Where the farmer has ploughed his lands in the winter he can plant from two weeks to one month earlier than the grower who waits for the rain to break his soil, and, as a rule, his yields will be proportionately larger. The first good rains usually occur in October, so that planting should be done from the middle of October to the middle of November. In the low veld, where frost seldom

occurs, planting can be continued somewhat later, but the rule should be to plant as early as possible. The longer the maturing period, generally speaking, the larger the yield.

The rows should be placed from three to four feet apart, depending on the fertility of the soil. On very fertile soil the rows should be placed four feet apart, but on poorer soils three feet to three and one-half feet is a more suitable distance.

The seed should be placed in the soil to a depth of two to two and one-half inches, and covered with fine, mellow soil. Planting can either be done by hand or with a planter. The latter is, of course, the more economical method. The rate of seeding is about 10 lb. per acre when planted by hand, and 15 lb. per acre when planted with a planter. This rate of seeding will give many more plants per acre than is desired, but it is better to thin out than to fill in.

Good yields depend to a large extent on good stands. Every missing plant reduces the yield of cotton, and thereby reduces the profit per acre. If the rows are placed three feet apart, and the plants stand eighteen inches apart in the rows, there should be 9,522 plants per acre. An average crop should give 1 lb. of seed cotton from every four plants, or 1 lb. of lint from every twelve plants. At this rate the 9,522 plants should give 2,380 lb. of seed cotton, or 733 lb. of lint per acre. If six plants were required to produce 1 lb. of seed cotton and eighteen for 1 lb. of lint, the yield should be 1,587 lb. of seed cotton, or 529 lb. of lint. The latter should be the average yield and the former should not be uncommon.

CULTIVATION.

As soon as the plants are up high enough to follow the row, cultivation should be commenced. The guiding rule of every grower should be, "Break deep and cultivate shallow." It is essential to break deep for the following reasons: To allow the tap root to penetrate deeply and thus safely anchor the plant; to provide loose soil for the feeding roots to ramify through in search of food and moisture; in order that the moisture holding capacity of the soil be increased and more plant food brought within the zone of the feeding roots. Shallow cultivation should be practised because "it has been observed that the lateral (feeding) roots commence about three inches below the surface and never go below the upper nine inches of soil." "Deep cultivation does not kill the weeds and grass more effectually nor better break up the surface crust, but it certainly does injure the feeding roots, which weakens the vitality of the plant.

As soon as the true leaves appear the plants should be thinned out until they stand about 18 inches apart in the rows. In this operation care should be taken, as far as practicable, to remove the weakest plants and leave only those that are strong and vigorous.

Cultivation should be practised often enough to keep down weeds and grass, and to keep a fine mulch on the surface of the soil. Either a single or two horse cultivator may be used, but the latter is more economical, as less labour is required to accomplish a given amount of work. Cultivation should cease when the plants begin to flower.

PICKING

When about one-third of the bolls are open, picking should begin. In picking only the seed cotton should be removed, and care should be taken to prevent dry leaves, portions of bolls, or other foreign substances from being mixed with the cotton, as unclean cotton is of lower value. Three to four pickings are required to harvest the crop. The first picking, as a rule, will give the largest amount of seed cotton, and the last picking the smallest amount.

In most parts of the Union the rains have practically ceased before cotton picking begins, so that there is little danger of the lint being discoloured by excessively wet weather. However, when the cotton is moist from light showers or from dew, it should be allowed to dry before resuming picking. In case the seed cotton is slightly moist when removed from the boll, it should be spread in the sun to dry before being stored. An excellent tray for this purpose is described by Mr. G. Elphick in the Agricultural Journal of June 1911.

Ordinary grain bags or bags of a similar size, made of coarse cotton cloth, are used as receptacles when picking. A riem or strong cord is fastened to either side of the mouth of the bag and then slung over the neck and one shoulder. This leaves both hands of the picker free. Natives are rather slow in the beginning, but can be easily taught so that they will pick sufficient cotton to pay their hire. They should be instructed to grasp each lock of the boll at the same time and to remove the cotton with a quick jerk. If each lock is removed separately, as they do at first, much more time is required in harvesting. Native women should pick at least 50 lb. of seed cotton per day and men should pick a bit more. Native men have been employed at the Rustenburg Station who averaged more than 100 lb. per day. The usual rate of pay is 1*s.* per day, so that the cost of picking in South Africa is practically the same as in the Southern States of America, where cotton is picked at a certain rate per pound, usually $\frac{1}{2}d.$

In this connection it might be well to state that pickers work with greater rapidity when picking the big boll varieties, than when picking the long staple varieties, as the bolls of the former open out better, and the cotton is thus better exposed to the clasp of the fingers.—Agricultural Journal of the Union of South Africa.

INDIGO.

A correspondent writes:—

With regard to indigo it is very doubtful whether the industry can now be revived as it is extremely difficult to get the rayats to cultivate it on the old terms. Indigo has more than doubled in price owing to the closing of the German factories manufacturing the synthetic dye, and those fortunate planters who have any in stock now will benefit greatly.

FRUIT.

BUDDING THE MANGO.

MR. WILLIAM BEMBOWER, B.Sc., of the Agricultural Department, Allahabad, contributes an interesting article on this subject to the INDIAN AGRICULTURAL WORLD.

Regarding the advantages of budding over inarching he says :—(1) Seedling trees may be started in the place where they are to grow and, when a convenient time comes, may be budded into any desired variety. This will give a good root and will ensure much greater success than many people have in transplanting nursery stock. (2) It will be easier to obtain varieties from a distance by this method, for only a bud stick needs to be sent through the mail at the proper season. (3) If the first attempt is a failure, the operation may be repeated, until success is attained. (4) Old trees might be made over into as many varieties as there were suitable branches. Thus, one might have several favoured varieties on one tree, should he only possess one plant in his garden.

He then goes on to describe two methods of budding. The first gives the experience of a student of the College as follows :—I budded my stock by the "shield bud method." Stalks about half inch in diameter were chosen and a T shaped cut was made near the ground. Then, the bark was separated with a knife and a shield shaped bud about one inch long, which was taken from a bud stick from some desirable variety, was inserted in the slit. The bark was then firmly tied with budding cloth which had been made by melting grafting wax and pouring it over some strong muslin cloth which was then torn into narrow strips about one-half inch wide and six or eight inches long. The usual base of the petiole was left on the bud ; and in tying, this was allowed to remain uncovered. The object of the wax cloth is to prevent the stalk from drying out and to prevent moisture and decaying germs from getting into the cut portion of the plant. After a few days, the petiole drops off ; and one may see whether the bud has remained green or not. If it remained green, the seedling was cut into slowly, at intervals of a few days, until entirely cut off. This was, of course, a short distance above the bud, thus allowing the strength of the tree to go into the bud. After the new branch has grown to considerable length, the stub may be entirely cut off, thus allowing the wound to heal over nicely at the junction of the bud and old stalk. By this method, I budded several plants last year, beginning in August and had six successes. The rains seemed to be the best time to do the work and, by tying a strip of cloth two inches long and one inch wide over the bud in such a manner as to shed water from the bud, I secured better results.

The second is a method successfully practised by MR. SIMMONS, who is in charge of the U. S. A. Agricultural Department's sub-tropical gardens in Florida, who writes as follows :—The method I wish to call attention to must be performed under certain conditions, the first and most important of which

is that the stock must be in active growth. The best time is when the leaves are not far enough developed to show the bright green colour. The bark is then most easily removed. Choose the thick part of the stem, only a few inches above the surface of the ground, cut a rectangular piece of the bark about 1½ inches in length and, from the variety to be propagated, cut out a similar piece with a bud in the centre, not, however, from new wood but from that which is at least two years old and which has lost its green colour and assumed the greyish brown tint. Fit the section of bark, with bud attached, into the space formed by the removal of the bark from the stock. If the piece of bark removed from the stock has a bud in the central part, the wood exposed to view will fit better with the section of bark to be applied. When the section has been put in place, with a small brush apply a light coating of liquid grafting wax, in which there is a large quantity of resin, to the cut parts and immediately tie firmly with thick pieces of raffia. Then, an eight-inch wide strip of strong wrapping paper wound round and round the stem a few inches above the bud and tied above with a cord, completes the operation for the time being. If good material is selected and the operation carefully carried out at the proper time, there is no reason why a high percentage of successful unions should not be secured.

C. D.

AN ALLEGED DANGEROUS GRASS.

Elcusine indica (Sin. Wal-Kurakan or Belatana) is a common roadside grass, of which the dry-grain known as Kurakan or Ragi, largely cultivated in Ceylon and India, is, according to Trimen, "a stout prolific form."

In a paper appearing in the August number of the Queensland Agricultural Journal it is described as a dangerous grass to stock.

An estimation of the amount of hydrogenic acid yielded by maceration with water of the fresh cut grass, and subsequent distillation, showed ·92 grains per lb., and it is thought likely that the amount would be greater where there was vigorous growth.

The writers of the article in question (Messrs. Frank Smith and C. T. White) state that they have no doubt that this grass can produce poisoning in animals feeding on it, and that cases of sickness in horses and sudden death of poultry having access to it are attributable to the poison. This raises an interesting question not merely as to whether Wal-kurakan may not be with us too the cause of unaccountable death among grazing stock and poultry, but also as to the possibility of a too stringent diet of Kurakan by human beings causing derangement of the digestive system may not be due to the action of a poisonous element in the grain.

C. D.

SOILS AND MANURES.

IRRIGATION AND SOIL NITRIFICATION.

These nitrification studies were carried out on the Grenville Farm belonging to the Utah Agricultural Experiment Station. The soils are of sedimentary origin and contain no particles larger than "fine sand." Chemical analysis shows them to be exceptionally rich in the mineral plant food constituents, but characteristically low in humus and possessing only a fair nitrogen content. The surface soil to a depth of one foot contains 43 per cent. of calcium and magnesium carbonate in the ratio of 1 lime : 2·8 magnesia.

The influence of irrigation and growing crops on nitrification was determined by measuring the rate of nitrification of ammonium sulphate and dried blood when added to samples of the soils. Water from the Logan River was used for irrigation and was of fairly constant composition during the season. Analysis showed it to have a very low fertilising value and to contain less than 400 parts of total residue per million.

The results obtained in these experiments are as follows :—

(1) The nitrifying power of the surface foot of soil was ten times that of the second foot and many more times that of the third, fourth and fifth foot respectively.

(2) Irrigation decreases the nitrifying power of soils, especially in the first two feet. This effect continues during the following season.

(3) More than 50 per cent. of the full water capacity of the soil is required for maximum nitrification, but the quantity varies considerably with different soils. Maximum nitrification is generally secured when the soil is just on the point of becoming sticky. Too small a supply of moisture has a greater effect in retarding nitrate formation in these soils than a too liberal application.

(4) The addition of a quantity of nitrogen as ammonium sulphate greater than 170 parts per million showed an inhibiting action on the nitrifying organisms. In no case was as much as 50 per cent. of the nitrogen added as ammonium sulphate recovered in the form of nitrate.

(5) Growing crops such as alfalfa, potatoes, oats and corn increase the nitrifying power of the soil, the effect being greatest in the case of alfalfa.

(6) The greatest gain in nitric nitrogen was obtained from the alfalfa land when ammonium sulphate was used as the nitrifiable substance ; when dried blood was substituted for ammonium sulphate, the greatest gain was from the oats land.

(7) The smallest gain with both ammonium sulphate and dried blood was obtained from the fallow land.—MONTHLY BULLETIN.

WORLD'S PRODUCTION OF ARTIFICIAL MANURES.

The production, consumption and trade in fertilizers is of an eminently international character, as no country is in a position to provide for all its own wants in that respect; moreover, while the use of artificial manures is gradually spreading to all cultivated parts of the globe, the raw material from which they are produced is concentrated in only a few points. The present edition of the above publication has been completed with regard to the world movement of fertilizers by data for the colonies which were not available in 1913.

PRODUCTION.

The world's production of the principal fertilizers during 1910, 1911 and 1912 is given in the following table, together with similar data for 1903:—

Total production of fertilizers (metric tons).

	1903	1910	1911	1912
Phosphatic manures				
Mineral phosphates	3,098,866	5,609,760	6,181,199	6,852,343
Basic slag ...	3,243,500	3,275,845	3,506,500	3,988,000
Superphosphate	5,130,000	9,604,260	10,000,000	11,000,000
Guano ...	71,000	61,000	83,000	72,000
Total...	10,544,366	18,550,865	19,770,699	21,912,343
Potash manures.				
Potash salts	4,078,268	9,285,408	10,985,760	12,531,216
(containing K_2O)	(366,421)	(857,883)	(939,927)	(1,009,219)
Indian saltpetre	18,711	16,140	14,910	15,036
Others (given as K_2O)	——	28,000—44,000		
Nitrogenous manures				
Nitrate of soda	1,485,279	2,465,415	2,522,120	2,586,975
Sulphate of ammonia	582,206	1,053,994	1,198,363	1,327,508
Cyanamide ...	——	30,000	52,000	95,000
Nitrate of lime ...	25	25,000	50,000	75,000
Total...	2,607,510	3,574,409	3,822,483	4,084,483

The Seychelles have recently provided a new source of guano, producing 22,260 metric tons in 1911.—MONTHLY BULLETIN.

THE SUPPLY OF POTASH.

The cessation of exports from the Stassfurt Mines in Germany, which constitute the principal and practically the only source of ordinary potash manures, raises the question as to what substitutes can be employed in the near future, and from what quarters these can be obtained.

For many years a considerable amount of work has been done in the United States and elsewhere with a view to rendering available the potash which is contained in certain well-known and widely distributed varieties (e.g. orthoclase) of the mineral called felspar. It will be remembered that this substance is a common constituent of many soils as well as occurring in vast quantities in certain rocks like granite. Trials have shown that it is not a paying operation to manufacture available potash from felspar for the sake of the potash alone. The discovery, however, that Portland cement can be obtained by the treatment of felspar with lime as well as available potash as a by-product, has of recent years rendered the idea practicable and indeed, several factories have been established for carrying out these operations. At the same time the unit price of potash from this artificial source is greater than that of the mineral obtained from natural mines, and up to the present this artificial supply has been altogether inconsiderable. There is reason to suppose now, however, that, owing to the complete cessation of the German supply which, as already intimated, has held a world monopoly, some possibility exists that a rise in price may render the artificial production of potash fertilizers feasible,—a circumstance of importance to those who are engaged in the production of certain crops.

Another alternative in the present situation might be to take advantage of the Indian supply of saltpetre (potassium nitrate). In 1906-7, India exported principally by way of Bengal, 353,378 cwt. of nitrate of potash, valued at Rs. 4,152,527 (£276,168). The largest quantities of this amount were distributed in order of nomination to the United States, United Kingdom, China (Hong-Kong) and Mauritius. The average value per hundredweight of Indian nitrate of potash for the five years preceding 1907 was 14·5*s*.

In connexion with the information just given it may be of interest to add a few words on the chemistry of nitrate of potash. It is obtained in India in the form of an efflorescence at the surface of the soil, and the conditions for the formation of the salt are briefly as follows: Supplies of nitrogenous organic matter; climatic conditions favourable to the growth and action of nitrifying bacteria which convert urea and ammonia successively into nitrous and nitric acid; the presence of potash; and meteorological conditions suitable for the efflorescence of the potassium nitrate at the surface. This necessary combination of characters is to be found in a marked degree in various districts in the Indo-Gangetic tract.

It is well known that nitrate of potash has an important use in the manufacture of explosives, and it is a further point to anticipate whether the Indian Government has not already prohibited the exportation of nitrate of potash under the category of contraband of war, in which case it would seem that agriculturists will have to look to either artificial mineral supplies

as dealt with in the first paragraph of this article, or rely upon the practice of carefully returning plant dèbris and wood ashes to the soil. Careful attention to this latter procedure should ensure adequately all necessary demands for potash. It may be noted, however, that there are one or two by-products of tropical crops in existence which are very rich in potash and may possibly come into use as an organic-potash manure, for example, Sesat seed from the Soudan, the ash of the husks of which is rich in nutrients containing as much as 42 per cent. of potash (K_2O). Material of this kind as well as sea-weed (also rich in potash) should prove very valuable.

Nitrate of potash is not used largely as a manure as it is rather expensive. For sugar cane in Barbados, however, and in other islands where the soil has to be kept rich in available plant food, nitrate of potash has proved useful and possibly economical because nitrogen being required as well as potash, the planter has in this manure two essential elements in a readily available form. Owing to the richness of nitrate of potash, its purity and complete availability, it is necessary to use only small quantities per acre, for example ½ cwt., which is significant as regards freight.

The usual guarantee for nitrate of potash is 17 per cent. nitrogen and 40 per cent. of potash, the unit prices for which are quoted at 14*s.* 6*d.* and 3*s.* 9*d.*, respectively.—The Agricultural News.

SOIL STERILITY IN JAVA.

Soil sterility due to the presence of excessive quantities of chlorides and sulphates is a well-known phenomenon in the Dutch East Indies; such salts are probably derived from flooded craters ; but a case of sterility has recently been investigated from the Pemaland district which revealed the presence of large quantities of soda mostly in the form of carbonate; the percentage being much higher than that given by O. Maior for sodic soils at Sipote (Jassy). This large quantity of soda accounts for the curious character of the Java soil: when it rains the soda forms absorption compounds with the soil colloids, thus producing hydrogels, then dries out very slowly, undergoing such a large decrease in volume that cracks appear at the surface.

Manurial experiments have already proved that the addition of 1·2 per cent. of quicklime produces a wonderful improvement, while the addition of 3·6 per cent. injures the vegetation but completely changes the structure of the soil, as the lime displaces the soda in the colloidal compounds and causes flocculation. Gypsum employed in similar cases in America and India gave even better results, as the sulphuric acid formed neutralizes the alkali which is injurious to plant roots.

Analyses of subsoil water revealed a content of 492 mgm. of sodium carbonate per litre, showing that the soda comes from the subsoil.—Monthly Bulletin.

THE CONSERVATION OF SOIL MOISTURE.

JOHN W. PATERSON, AT THE BRITISH ASSOCIATION MEETING, AUSTRALIA.

A sufficient supply of soil moisture was, practically speaking, the paramount factor in crop production. This was true in the relatively moist climate of Great Britain; the fact was illustrated in an extreme degree in Australian agriculture. Seasonal variations were less marked in Western Australia than in the Eastern States, and a graph was exhibited showing the variations in wheat yields per acre of the various States since 1901. The effects of drought were not simply connected with the annual rainfall of a locality. This was a popular fallacy; but when a crop suffered from drought the result was contributed to by quite a number of factors. Among those he would mention—(1) the total annual rainfall, (2) its monthly distribution, (3) the rate of evaporation as from a free surface of water, (4) the effect of climate upon the transpiration ratio of the crop, (5) the amount of soluble salts in the soil, (6) the physical character of the soil, (7) the skill in cultivation of the farmer, (8) the selection of drought resistant species and varieties of crop-plant. In regard to annual rainfall, the South-Western corner of the state averaged well over 30 inches, but on the eastern fringe of the wheat belt wheat could be successfully grown with a 10-inch rainfall, but the greater part of the wheat area had an average of 14 to 20 inches. To visitors these amounts would seem low. The monthly distribution, however, was highly advantageous, as from 70 to 80 per cent., fell between an autumn seed-time and harvest. The third factor, viz., rate of evaporation, tended, however, against success, and data were quoted from the Commonwealth Weather Bureau showing that the annual loss by evaporation in the wheat belt ranges from 60 to 80 inches of water, as against about 20 inches in the South of England. In England therefore the annual evaporation would amount to about two-thirds of the annual rainfall, while in the chief farming districts of Western Australia it was from four to six times greater than the rainfall. Closely connected with this in some, but not all, of its contributing causes was the lower efficiency of water to the growing crop, as indicated by the amount required to produce a given weight of dry plant substance. The transpiration ratio was indeed less a function of the kind of crop speaking of the common crops) than a function of the climate, and the author quoted from experiments he had carried out showing that on land of moderate fertility a ratio of 600 to 700 would be required for the wheat areas. This was roughly double the English ratio. Again, as regards soluble salts, the drier areas commonly held a slightly higher percentage than British soils, and while in Western Australia "alkali" rarely of itself caused fertility, his experience of alkali lands which he had investigated for the Victorian Government, indicated that such salts increased the liability of crops wilting. On consideration they would expect this. Again, the physical character of the soil had an important effect, and the sandy character of much of the western lands gave it an advantage over the heavier soils in a dry season. This was contradictory to his experience in the English Midlands with a 32-inch rainfall. Fifteen inches of rain absorbed by the surface five feet of

soil would add something less than 20 per cent. of water calculated on the dry soil if it were absorbed without loss. But the annual rainfall was spread over several months, and the fact seemed to be that with a 15-inch rainfall the sandy soil could hold all the rain which fell, and the greater absorbent power of the clay soil was then of no advantage. It was indeed a disadvantage, as the finer-grained soil could not yield up so much of its absorbed water before wilting set in, and in the drier seasons and districts the "sand plain" gave superior results to the forest land. In regard to cultivation methods, the author quoted figures from his experiments showing the large saving of soil moisture by early cultivation and maintaining a soil mulch. The water saved would usually equal from 5 to 7 inches of rain in the surface five feet of soil. In Western Australia good results from fallowing were more easily obtained than in Victoria, where the more frequent summer rains tended to cake the surface, rendering fresh working of the land necessary. The water saved showed itself in the crop yields, and the results of a Kellerberrin farmer last season, showing 17 bushels on sand plain followed, and 5 bushels on similar land ploughed from stubble, could be regarded as typical under a 12-inch rainfall. The British farmer did not sufficiently realize the use of the soil mulch in protecting his winter ploughed lands from the drying winds of spring. Lastly, as to the selection of drought-resistant plants, much had been done through acclimatisation, selection, and cross-breeding, but a careful analysis of the various factors which in wheat constituted drought-resistance remained to be carried out before they could claim that plant-breeding for this object was placed on a scientific basis. Under the dry conditions of Australian wheat-growing a safe yield rather than a heavy yield was the primary consideration. This necessitated the selection of early or middle-early varieties, thin seeding, and in the great majority of cases the non-use of nitrogenous manures.—JOURNAL OF AGRICULTURE, VICTORIA.

RAINFALL FOR JUNE, JULY AND AUGUST, 1914.

Place.	June.		July.		August	
	1914.	1913.	1914.	1913.	1914.	1913.
	in.	in.	in.	in.	in.	in.
Colombo ...	10·29	5·27	3·65	6·62	1·65	1·17
Kandy ...	9·30	6·26	5·96	5·76	4·63	4·55
Galle ...	11·15	4·22	6·07	7·64	4·68	4·64
Jaffna ...	0·56	0·06	0·00	2·08	0·62	0·18
Anuradhapura ...	0·26	0·45	0·00	2·34	0·14	0·21
Kurunegala ...	5·88	4·82	0·55	2·63	0·83	1·69
Batticaloa ...	1·15	0·08	1·15	0·65	2·28	2·02
Badulla ...	0·66	0·49	0·33	0·82	0·91	0·10
Ratnapura ..	16·51	6·05	9·77	7·70	7·57	8·33
Nuwara Eliya ...	10·90	7·07	12·39	9·34	6·67	8·47

POULTRY.

HATCHING EGGS IN CHINA.

Certain of the Chinese in the interior districts adjacent to Amoy employ an ingenious method for hatching both hens' and ducks' eggs. The breeder first takes a quantity of unhusked rice and roasts it, cooling it down by fanning or allowing the wind to blow through until it is lukewarm. He then spreads a 3-inch layer of the rice in a wooden tub and places about 100 eggs thereon ; another layer of rice, this second and subsequent layers being but two inches in thickness, is spread over the eggs. Each tub will have six layers of rice and five layers of eggs, so that there will be 500 eggs in each tub. The rice is heated once every twenty-four hours, the eggs being taken out at such times. When the eggs are again put in the rice, the bottom layer is placed on top, and each of the other layers one row lower down, while the eggs previously in the centre of the tub are placed at the edge. The entire tub is covered with a cotton mattress. One of the great difficulties with this method is the inability to tell just when the eggs will hatch, which, of course, renders the smothering of the young ones very possible. The measure of success of the breeder depends largely upon his ability to care for the chicks at this time.—JOURNAL OF THE ROYAL SOCIETY OF ARTS, JULY, 1914.

THE COMMERCIAL SIDE OF POULTRY KEEPING.

To rear poultry as an adjunct to dairy-farming, pig-breeding, or market gardening is one thing. To rear poultry for profit on a poultry farm is quite another proposition. The REV. T. W. STURGES, M.A., discussing this matter in his exhaustive work on poultry, says that poultry-keeping as a hobby is a delightful occupation, and to the vast multitudes who undertake it for this end is due the fact that it may sometimes be made a commercial success. There is no reason why anyone of average intelligence should not make his poultry repay him for the trouble bestowed. But to make it the sole business of life from which the maintenance of a man and his family may be derived is quite another matter. To look upon the calling as a sort of oasis in the desert—an Arcadia of life, where fruits grow without the planting or watering —is little short of a delusion. Many have made a shipwreck of their hopes in attempting it ; of the many who have tried it none have found it to answer, or, if any have done so, they have kept the fact a profound secret. That the small farmer who keeps twenty or thirty head of poultry has found it reasonably profitable is no answer to the question. The food bill on a farm is small, and the garden and house scraps supply the bulk of it. The case is

very different with the poultry farmer pure and simple. His expenses are heavy for feed, housing, transport, etc. There are delusive books—fairy tales which narrate such easy problems as : "If 4 hens cost £1 a year to keep, and lay eggs, which, at 1*d.* each, bring in £2, or £1 profit, then 400 hens will bring in £100, and 4,000 hens £1,000 ;" and so on. Other misleading statements are based on a single hen bringing in 30*s.* a year ! Multiply this by 200, and you have £300 a year. All you need for this is a cottage and a couple of acres of land, since every hen will lay in the winter 100 eggs, which sell at 2*s.* a dozen ; and those she lays and hatches in the summer will find a ready sale as day-old chicks at a guinea a dozen, etc., etc. When a new breed shall have been discovered with a clockwork interior which needs only a yearly winding up, and is guaranteed to keep time, then "success will be certain." Meanwhile, we wait !

If these schemes were practical on a colossal scale, millionaires would be as plentiful as blackberries in autumn. MR. STURGES puts it down as a very good average result that, if a poultry farmer on this system gets 5*s.* per head, he is doing well. And if he has 400 birds to look after, and has to raise his yearly flock of chickens to replace the old ones, he will be fully occupied. Where one man does this, seventy fail to do so ; most who have tried it have to be content with less, and very many have failed to make both ends meet. But, it will be said, "There are poultry farmers who earn a good livelihood." The answer is, "Yes, there are many who do so, but it is not by such methods." These are men who have made a study of the business, and have not taken to it because they have failed at everything else. They have either served an apprenticeship to the business with those who have already been successful, or have served the longer apprenticeship of experience.

The people who make a good livelihood out of poultry farming are not those who keep hens simply to supply the table with fresh eggs and dead poultry, but those who breed purebred poultry of the more popular breeds and varieties and sell the eggs for hatching purposes, and raise stock and sell them to others for breeding or for exhibition, or exhibit the birds in their own names.

MR. STURGES divides these roughly into two classes—(1) Those who breed chiefly for exhibition purposes, and by means of advertising and exhibiting their stock, get enhanced prices for them, as well as high prices for the eggs they sell for hatching. (2) Those to whom exhibiting is only a minor part, but who breed high-class stock, and sell a great number of both for breeding and for laying to the very large number of patrons who like to see purebred stock about them. It is entirely due to the fancier that we have breeds and varieties of fowls that will lay from 150 to 180 eggs or more a year. The absolute mongreldom which still prevails on the average farm homesteads, as well as in the cities and suburbs, would have been universal had it not been for the fancier and his carefully selected stock.

As far as eggs for the markets is concerned, there is an unlimited demand all over the State. Grocers and other tradesmen who sell them are always willing to buy and pay fair prices for clean, fresh-laid eggs, prices fluctuating, of course, according to the season of the year.—THE QUEENSLAND AGRICULTURAL JOURNAL.

ENTOMOLOGY.

STAUROPUS ALTERNUS, WLK.

THE LOBSTER CATERPILLAR.

From time to time specimens of this caterpillar are received usually with a note calling attention to its unusual shape, and expressing the hope that it is rare. So far as my experience goes it has been confined to single bushes of tea and some such record as the following invariably accompanies the request for information :—" The bush it was on was entirely eaten away and only the hard stems left." But GREEN records a case where a considerable acreage was practically defoliated. That was in 1903 in the Kalutara district (vide Circular R. B. G., Vol. II., No. 5 for a full report). Until last year there seems to have been no complaint made since 1905. It has been recorded from Kelani Valley, Kalutara, Neboda, Maskeliya, Ingiriya, Dehiowita, Peradeniya, Ohiya, Pelmadulla and Kotmale. In addition to tea it has been found feeding on Cacao, Mango, *Albizzia stipulata*, *Acacia decurrens*, *Acacia dealbata*, *Grevillea robusta*, Rose (GREEN), *Cassia Fistula* (THWAITES), *Cajanus indicus* (LEFROY), *Tamarindus indica* and Tur (FLETCHER).

There is no mistaking the caterpillar though, unless in the way it bends its body and in the number of appendages it possesses, one must not expect to see any resemblance to a lobster. It clings to the edge of the leaf and eats pieces out of it. The colour varies with the age of the caterpillar. A full-grown or almost full-grown caterpillar (about 2 inches long) is reddish brown, minutely hairy, and covered with minute, white tubercles. The head is broader than the thorax. The antennæ are three-jointed, the third joint long and bearing a long hair at the apex. Mandibles are black and truncate at apex. The first pair of legs is abnormally short. The third thoracic and first six abdominal segments bear each a pair of conical, spiny warts on the dorsum, those on the first three abdominal segments being prominent. There are large prolegs on abdominal segments three to six, the last pair being the stoutest. When the caterpillar is at rest the fourth pair is directed ventro-caudad ; the remaining segments of the abdomen are held erect ; these segments are extended laterally in the form of a flange, the edges of which bear small, black tubercles. Caudally in the position of anal prolegs are two, long, curved processes, black along their mesal sides and with a slight lobule dorsally near the apex.

When the caterpillar is striking its characteristic and presumably protective attitude the head and thorax are raised and recurved so that the dorsum of the head comes close to the apex of the abdomen. The spiracles are grey, oval and surrounded by a black edge. Ventrad of the first and second abdominal spiracles is a black spot, obvious when the caterpillar is feeding, but obscured when it is attitudinising.

There is present a pale coloured, mid-dorsal band, while the abdominal segments as far as the sixth are more or less pale either on the dorsum or on the sides. The cephalic aspect of the tubercles often bears a white stripe. The larvæ are said to eject from the mouth a fluid which causes blisters and may produce considerable pain if it gets into a wound. (Green.) This has to be taken into account when large numbers of the caterpillars have to be collected. In the case of a severe infestation, when the caterpillars have reached some size, it is advisable to prune the infested area and burn the prunings. But should an attack be observed when the caterpillars are still small and there is still a considerable amount of leafage on the bushes, resort should be had to an arsenical spray. The caterpillars when full-grown pupate in a loose cocoon composed of rather coarse, yellowish-white silk and spun between two leaves or in the angles of the branches. The pupa is of a chestnut colour and shining. The cremaster consists of four minute hooks. The adult moth emerges in from seven to ten days. It is active by night. During the day it is sluggish and rests on rocks and stems of trees, with which its colour harmonises. The practised eye, however, has no difficulty in detecting them, and following an emergence large numbers can be caught and killed.

Hampson describes the moth as follows :—

"*Male :* Antennæ pectinate. Expanse 44 mm. Head and thorax brownish-grey ; abdomen grey-brown with dorsal tufts on first six segments darker. Forewing brownish-grey with indistinct antemedial and postmedial pale waved lines ; a submarginal series of rust-red spots with pale lunules inside them. Hind wing whitish with costal and inner areas brown ; both wings with a marginal series of pale and red-brown lunules underside brown.

Female : Antennæ ciliated. Expanse 62 mm. Hind wing uniform brown."

Distribution ; India, Ceylon, Rangoon.

The moth rests with the front wings folded back so as to expose part of the hind wings.

The eggs are laid on the upper and under surfaces of the leaves. Each is circular, flattened dorso-ventrally and yellowish to whitish in colour. According to Green they are usually laid at intervals along the edges of the leaf.

An attack can also be made on the pest at this point of its life-history by collecting and burning the leaves that bear eggs. The appearance of the caterpillar and its potentialities for doing harm should be known to every planter.

A. RUTHERFORD,

HETERODERA RADICICOLA. MUELL.

OR "EELWORM."

Eelworm is a frequent cause of root disease in plants in many parts of the world. It attacks a great variety of plants, and plants of all ages, but it is among annuals and plants in the nursery that the injury done is most conspicuous. Very often the roots are knotty, and in some cases the disease is spoken of as "root-knot." But eelworm may be present even

when such knots or swellings are absent, as is the case in the eelworm of citrus in California.

Injury by eelworm is done in two ways, firstly by the withdrawal of food from the host plant and secondly by the disorganisation of the food-carrying tissues of the plant.

Recently tea seedlings infested with eelworm were received from Pussellawa. The seed had been planted in January and all the plants had come up well; "but now (end of July) they seem to hang fire and not only do not appear to grow but the majority have an unhealthy yellow look about them, while here and there all over the nursery several have died." In the specimens sent the chief injury was done at or just above and below the collar; there the plant was rough, swollen and somewhat corrugated longitudinally. The root did not shew any very conspicuous swellings. In favourable circumstances the worms may be seen even with the unaided eye. If a piece of the more recently attacked stem be broken off with the finger nail, white, shining spots may be seen. These are the worms. With the aid of a pocket lens elongated, spindle-shaped ones, and short flask-shaped ones may be distinguished; the latter are the adult females, the former are either larvæ or males.

It is mainly by the transference of infected plants or parts of plants, or of soil on feet, wheels or implements, or by rain washings that new ground is infected, as the worms do not appear to be able or willing to travel far.

In Ceylon eelworm has been recorded from Ambawella, Badulla, Haldamulla, Lindula (on tea and albizzia) Nuwara Eliya (on pea) Peradeniya and Pussellawa.

Eelworm is a pest which is not easily got rid of and this is especially true in the case of field-crops. A good deal of work has been done on this subject in the United States of America, and some of the most important results are given below.

In green houses and seed beds the steam and the formaline treatments have given satisfactory results; the formaline is used at the strength of one part of commercial formaline to 100 of water and at the rate of 1 to $1\frac{1}{2}$ gallons per square yard; after treatment with formaline fully a week should be allowed to elapse before planting or replanting is undertaken, the soil meanwhile being frequently stirred.

In the field Carbon bisulphide has given fairly satisfactory results (re the use of this substance see "T. A." December 1913.)

Deep cultivation and a liberal application of nitrogenous and potassic fertilisers will help the plant over the most critical time by enabling it to strike its roots deeply and widely; these fertilisers were found to be very favourable in the sandy, somewhat potash-and-nitrogen-free soils of South Carolina.

It must not be expected, however, that such fertilisers will get rid of the eelworm. This can be accomplished only by the use of carbon bisulphide, by starving them out or by flooding. To starve them out the land should be kept free of all vegetation for two years, or plants not susceptible to eelworm attack should alone be planted. A few non-susceptible plants

are, according to an article in the MONTHLY BULLETIN of the State Commission of Horticulture, California—Cow-pea (iron variety), Sorghum, Kaffir corn. Flooding is, in the majority of cases, impracticable. When the soil has been freed of all plants that would serve as hosts to the worm submergence for a period of fifteen to twenty days has given favourable results.

Eelworm is very susceptible to drought and their numbers can be greatly reduced by tilling deeply after the last rains and thereafter leaving the ground untilled during the hot dry season.

A few of the susceptible plants of interest to tropical agriculturists are, on the authority of BESSEY :—

Acacia dealbata, Link, and several Australian species ; *Arachis hypogæa*, *L.*, pea-nut ; Avocado (*Persea gratissima*, Gærtn) ; *Phaseolus* various spp. ; *Musa* various spp. ; Beet (*Beta vulgaris*, L.) ; Cassava (*Manihot utilissima*, Pohl.) ; Cacao (Theobroma cacao, L.) ; *Citrus* various spp. ; *Coffea* various spp. ; Cotton (*Gossypium* various spp.) ; *Cucurbita* various spp. ; *Desmodium* spp. ; *Erythrina cristagalli*, L. ; *Ficus* various spp. including *F. elastica*, Roxb. ; *Glycine hispida*, (Moench) Maxim, Soy Bean ; *Vitis* various spp. ; Guava (*Psidium guajava*, L.) ; *Hibiscus* various spp. ; *Ixora* various spp. ; *Lantana horrida*, H.B.K. ; Maize (*Zea mays*, L.) ; Papaw (*Carica papaya*, L.) ; *Piper* various spp. ; *Ananas sativus*, Schult. pine-apple ; *Cajanus indicus*, Spreng, pigeon-pea ; Potato (*Solanum tuberosum*, L.) ; *Pithecolobium saman*, (Jacq) Benth., rain tree ; Sugar Cane (*Sarcharum officinarum*, L.) ; *Ipomœa batatas*, (L.) Poir, sweet-potato ; Tobacco (*Nicotiana tabacum*, L.) ; Tomato (*Lycopersicum esculentum*, Mill.) ; Yam (*Dioscorea illustrata*, *Hort.*)

A. RUTHERFORD.

ERRATUM.

After "prominent," line 47, page 322 read : "orange-coloured tubercles on the first thoracic segment. The dorsum of the first and second abdominal segments bears prominent tubercles," that etc.

THE SEEDLESS BREADFRUIT.

P. J. WESTER.

The seedless breadfruit is one of the best and most nutritious fruits in the Philippines, but it is also one of the rarest owing chiefly to the difficulty of propagating it. The ability of the roots to sprout under certain conditions led to a series of experiments being carried out in 1913 at the Lamas Experiment Station with the object of finding a simple and practical method of propagation. The following method gave good results: Root cuttings 20 to 25 cm. (8 to 10 in.) long and 1·5 to 6 cm. ($\frac{1}{2}$ to $2\frac{1}{2}$ in.) thick are struck in a bed consisting of a layer of clear sand 18 cm. ($7\frac{1}{2}$ in.) thick situated in a sheltered and well-drained position. The cuttings are inclined at an angle of 45° and buried three-quarters of their length, being set 20 to 30 cm. (8 to 12 in.) apart in rows 30 to 50 cm. (12 to 20 in.) apart. If planted in the rainy season, the cuttings require no further care; if not they must be watered. When 20 to 25 cm. (8 to 10 in.) high the cuttings are transplanted to a rich shaded soil, and when the plants are 60 cm. (24 in) high they are ready for transplantation to the orchard. The roots should be disturbed as little as possible during the operation and a large ball of earth be moved with the plant. In replanting it is important not to set the plant deeper in the soil than it was in the nursery and a plentiful use of water should be made both before and after the operation.—PHILIPPINE AGRICULTURAL REVIEW.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

Annual Meeting held on August 11th, 1914, at Queen's House, Colombo.

The annual meeting of the Ceylon Agricultural Society for the year 1913-1914 was held at the Executive Council Chamber, Queen's House, Colombo, on Tuesday the 11th August, 1914, at 12 noon, HIS EXCELLENCY THE GOVERNOR presiding.

There were present:—The Hon. Sir S. C. Obeyesekere, the Hon. Sir Hector van Cuylenburg, Sir P. Arunachalam, the Hon'ble Mr. A. S. Pagden, the Hon'ble Mr. J. G. Fraser, the Hon'ble Mr. L. W. A. de Soysa, Rev. Father Paul Cooreman, Meedeniya Dissava, Ratemahatmayas L. B. Bogahalande and J. G. Tennekoon, Mudaliyars Henry Perera, A. E. Rajapakse, Tudor Rajapakse, Messrs. A. W. Beven, G. W. Sturgess, H. L. de Mel, K. B. Beddewela, T. Petch, D. S. Corlett, M. Kelway-Bamber, H. F. Macmillan, B. Scherffius, C. E. A. Dias, J. D. Vanderstraaten, R. Chelvadurai-Proctor, John Clovis de Silva, H. Inglis, D. H. Kotalawala, A. P. Goonatilleke, Dan Joseph, Gerald Joseph, and C. Drieberg, Secretary. A number of visitors were also presnt.

Minutes of the last annual meeting held on August 12th 1913, were read and confirmed.

The Secretary gave a summary of the Report which was adopted on the motion of SIR P. ARUNACHALAM, seconded by SIR HECTOR VAN CUYLENBURG.

Annual Statement of Accounts for the year 1913 was duly adopted on the motion of MR. DE MEL, seconded by MR. A. E. RAJAPAKSE.

MR. B. SCHERFFIUS, Tobacco Expert, read a paper entitled "Brief Notes on the Tobacco Industry" on which H. E. THE GOVERNOR, SIR PONNAMBALAM, and MR. A. W. BEVEN spoke.

MR. BAMBER gave a summary of his paper on the possibilities of a castor industry in Ceylon especially as a mixed crop with other products.

The paper by MR. N. WICKREMARATNE, on local experiments with Indian lac cultivation, was taken as read.

HIS EXCELLENCY thanked the writers of the papers.

At the conclusion of the meeting a group photograph of those present was taken to commemorate the first decade of the Society's existence.

C. DRIEBERG,
Secretary, C. A. S.

12th August, 1914.

THE COLLEGE OF TROPICAL AGRICULTURE.

PROFESSOR DUNSTAN'S visit did much to arouse interest in the proposed College, and more than one consultation with local representatives took place.

Subsequent meetings held last month in London have gone to strengthen the claims of Ceylon as the site for the College (assuming there is to be but one) and it would appear that all practical details have been settled except the question of funds, which is no small one.

In his inaugural address the President of the International Congress of Tropical Agriculture dwelt forcibly on the need for such an institution for turning out trained investigators who would be able to fill up the large gaps in our present knowledge of the complex subject of Tropical Agriculture and help to find solutions to the problems with which we are so often suddenly confronted. He pointed out that we had come somewhat slowly to the recognition of the fact that tropical agriculture was an applied science, and to the reflection that progress would have been more rapid and less costly had it been effected more generally under that enlightened direction which depends on the considered application of scientific principles.

This Society which can claim some credit for the initiative it has taken in this matter, would share in the hope that Ceylon will lead the way in providing for technical education and research in tropical agriculture.—C. A. S. Report.

PUNJAB AGRICULTURAL COLLEGE.

A new course has commenced in the Punjab Agricultural College at Lyallpur in place of the three years' diploma course, for which students have not been forthcoming.

The new course will be divided into two parts, each of two years' duration. The first part is complete in itself and will qualify the students who successfully pass through it for employment in the Agricultural Department as agricultural assistants on a starting pay of not less than Rs. 40 per mensem, rising by increments to Rs. 100 per mensem. The entrance qualification for this course is the entrance examination of the Punjab University. The course will consist for the most part of tuition in agriculture, but lectures in English, arithmetic, agricultural chemistry, agricultural botany and entomology will also be given. The course will also include practical workshop instruction in the college workshop as well as courses in veterinary science and land surveying. The fees for the first two years' course will be Rs. 6 per mensem for all Punjabi students and Rs. 9 per me sem for all students from Native States and foreign provinces.

The hostel fees will remain as hitherto—namely Rs. 32 per annum. The subscription for games, societies, etc., is Rs. 7 for the year.

A leaving certificate will be granted on the result of an examination to be held at the end of the course.

Ten Government scholarships of a value of Rs. 6 per mensem will be given each year to students who are members of agricultural tribes on the result of an examination which will be conducted by the college staff at the Agricultural College on or about the 10th of May. The examination may be either written or oral or both.

A number of other scholarships and medals are given in this and the second part of the course, and for full details concerning them reference may be made to the new prospectus and syllabus, copies of which may be had on application to the Principal of the College.

In addition to the course detailed above there will be given a further two years' course for the diploma of Licentiate in Agriculture. The entrance qualification to this second course will be a first class leaving certificate for the first part.

In the second course tuition will be given in more advanced agriculture, and systematic instruction in the sciences of chemistry, botany, entomology and engineering as applied to agriculture, as well as in land revenue and

veterinary science. The scientific tuition in the second part will be approximately of the same standard as that given in the old three years' diploma course.

At the end of the course there will be an examination conducted jointly by the college staff and external examiners, for the diploma of Licentiate in Agriculture. This diploma of Licentiate in Agriculture will qualify its holders for promotion into higher grades of the agricultural service and agricultural assistants desiring to rise above Rs. 100 per mensem will ordinarily be required to obtain this qualification.

The Principal of the College keeps a register for the employment of old students both for employers and for students requiring employment.

He will be glad to assist landlords to obtain suitable assistants or old boys of the college to obtain employment.

The fees for the second course will be Rs. 12 per mensem for Punjabi students and Rs. 15 per mensem for students from Native States and foreign provinces.

Five Government scholarships of a value of Rs. 12 per mensem will be given on the result of the leaving certificate examination at the end of the first part and tenable for two years to students, who are the sons of cultivators or owners of land in the province.

The new class is not yet full, and the Principal of the College will be glad to receive applications for entrance and to interview prospective pupils any morning at the Agricultural College up to and not later than the 31st August, 1914.

The rates above noted for fees and scholarships have not yet received the sanction of Government and may be subject to some alterations and additions.—CIVIL AND MILITARY GAZETTE.

SUDAN DURA IN CEYLON.

This is showing a most satisfactory growth, and some interesting results may be expected next month. It is clearly demonstrated that it likes high, dry, well-drained, gravelly soil and dislikes low-lying, swampy, heavy soil or too much rain. Everywhere where water has settled and in poorly drained portions of the plots, the plants are half the size of the rest. The most forward plants started flowering fifty days after sowing. Again, the plot manured with cattle manure for the Sorghum and Maize crops nine months ago and not since manured, shows a marked advance over the other plots, which only had artificial manure at the same time. But all these plots show an improvement after the new drainage scheme and the dressing of lime. At the end of July the Dura was attacked by Aphis, which however soon disappeared and has done no harm. One of the varieties shows a much stronger and healthier growth, not so tall but with much broader foliage, than the other three, but flowers about 20 days later. Some of the Dura sown in the Show-plots where green manures had previously been sown, show a very fine growth, being over seven feet high.

Dura re-plants well when thinning out, provided there is plenty of rain at the time, but the crop from such transplanted plants is of course much later and of small size and quantity. The Dura has been twice weeded in 10 weeks.—PROGRESS REPORT, EXPT STN: PERADENIYA.

PRUSSIC ACID IN SORGHUM.

In view of the publicity which has been given to the Sorghum crops at Peradeniya and the efforts being made by the Department of Agriculture to establish this product in various parts of the island the following paragraph is reproduced from WATT'S COMMERCIAL PRODUCTS OF INDIA to serve as a warning to stock owners:—

PEASE (*Agri. Ledg.*, 1896, No. 24, 225) has recorded the death of a large number of cattle at the Sirsa fair, due to their having eaten *juar* stems. The young plant has frequently been found to be poisonous to cattle in Egypt, the West Indies, United States and elsewhere. DUNSTAN and HENRY have examined young sorghum plants from Egypt and India and have shown that these when ground up in contact with water yield prussic acid and that the prussic acid originates from the interaction of a crystalline glucoside *dhurrin* and the unorganised ferment *emulsin*, both of which occur in the plants and are brought into contact in the manner just indicated. In Egypt the amount of dhurrin, and consequently the quantity of prussic acid obtainable, is at a maximum when the plants are about 12 inches high, after which it gradually disappears as the plant matures (*Phil. Trans.*, 1902, cxix. a,399). Apart from the variation in the amount of prussic acid obtainable, which accompanies the ripening of the plants, variation appears also to be caused by climatic and other influences since sorghum plants at the same stage of growth yield different quantities of prussic acid in different countries.

All kinds of sorghum are liable thus to become poisonous in the green state, especially when their growth is checked by drought or other causes. The grain and dried stems are never poisonous.

KAINIT AS A WEED DESTROYER.

While it has been recognized for some years that kainit may prove effective in destroying weeds the results obtained hitherto have been considered too variable to warrant this manure being used to any extent for this purpose in place of the usual vitriol sprays. Lack of success in the past has been mainly due to an imperfect acquaintance with the conditions which should prevail at the time of application and the present investigations were undertaken by the Royal Agricultural Academy of Bonn-Poppelsdorf, at the Institute for Soil Investigation and Plant Growth, to ascertain what these conditions should be and also to determine if the use of kainit for destroying weeds could be economically justified. Of the results obtained from the investigations, the following may be noted.:—

1. Kainit is quite effective in destroying weeds provided the conditions at the time of application are favourable.

2. Not less than 1,050 to 1,250 lb. per acre should be applied and up to 1,800 lb. per acre may be used with advantage according to the stage of development of the weed.

3. Complete success can only be expected if the kainit is distributed when the plants are wet with dew or rain and the remainder of the day is free from rain. In cloudy, dull weather, although the kainit is quite effective, some time elapses before the weeds are destroyed.

4. Kainit is most effective when the ground is frozen, but applications at this time are not recommended as the seed corn is also harmed.

5. Fine grinding and a uniform distribution of the kainit enhance its useful effects.

6. Kainit is much more effective if it is applied when the weeds are in the earlier stages of growth.

7. Kainit does not kill all weeds. It is most effective when used against charlock, wild radish, bindweed, speedwell, chickweed, nettle, groundsel and cornflower; less effective against persicaria or redshank and spurrey; and only slightly effective against spreading orache, sow thistle and fumitory.

8. Top dressings of kainit on heavy soils may cause undue consolidation of the surface soil, but this may be counteracted by applying a sufficient quantity of lime.

9. As the potash in the kainit is utilised either by the crop to which it is applied or remains available for succeeding crops, there is no wastage from a manurial standpoint.

10. Generally speaking no ill effect is produced on the cereal crop itself. When the heavier applications are made the crops may sometimes suffer at first but soon recover. Pulse crops appear to be most liable to damage.

11. As the potash is utilised by the crops the cost of applying the kainit for weed destruction is comparatively trifling, the only additional cost being that entailed by the extra fineness of grinding.—JOURNAL OF THE BD. OF AGRICULTURE.

A STANDARD WORK ON TROPICAL GARDENING.

MACMILLAN'S well-known work has just passed into its second edition, and this is not to be wondered at considering the popularity of the book which is rarely found missing from the shelf of anyone interested in planting or gardening.

The original work has practically been re-written and brought up to date, while the illustrations have doubled in number.

The 662 pages are furnished with an admirable index which makes the varied information it contains easily accessible.

The author's intimate acquaintance with the Eastern tropics, and his knowledge of the people, their language and practices, have given him advantages of which he has made the very best use; and all lovers of horticulture are beholden to him for embodying in a single volume the experience of half a life time.

The publishers are MESSRS. H. W. CAVE & Co., Colombo, who have turned out the book with their usual finish.

C. D.

CATCH CROPS IN NEW CLEARINGS.

In the course of correspondence on this subject, an experienced planter in the Kegalla District kindly furnished the Secretary of the Ceylon Agricultural Society with figures to show the value of Plantains and Cassava as catch crops in young coconut and rubber plantations. Writing as he does of facts gathered from his own experience, his contribution is of special value.

In reproducing these interesting statistics it may be remarked that in the case of plantains Rs. 1·50 per clump for the 2nd year seems rather too much to expect in every case, and an estimate of Re. 1/- would be a safer average.

Twelve to fourteen thousand lb. of cassava (5—6 tons) is a pretty high yield for a catch crop, though 10—12 ton crops have been recorded on fully-planted land. The length of the cassava cuttings (4 inches) indicates great economy in cost of planting as the average length of cuttings is 9 inches.

(1) PLANTAINS.

Expenditure in Cultivating 1,000 bushes :—

First Year.

	Rs. cts.
To 1000 plantain suckers, inclusive of transport, &c. @ 10/-	100'00
.. 1000 holes 2 feet by 2 feet at 6/- per 100	60'00
.. Transporting to field and planting same	20'00
.. Supplies, &c.	25'00
.. Watcher, say 10/- per month	120'00
	325'00

Second Year.

To Supplying	25'00
.. Cleaning round trees and heaping them, say 4 times in the year	25'00
.. Watcher	120'00
	170'00

Third Year

To Cleaning round trees, say 4 times in the year	25'00
.. Watcher, say 10/-per month	120'00
	145'00
Total Expenditure for the three years	640'00

Income.

From the 2nd year—the 1,000 trees could be given on a lease at Rs. 1'50 each = Rs. 1,500'00

From the 3rd year—the 1000 trees could be given at a Rupee each Rs. 1,000'00

The sale of 2,500 plantain shoots at 50/-per 1000 Rs. 125'00

Total Income Rs. 2,625'00

The expenditure can be reduced if the watchers are made to clean round the trees and attend to the manuring. Plantains do best if holes are cut and suckers planted before the ash and surface soil are washed away by rain.

After the 3rd year's crop, I would advise the entire removal of all plantains from the field if they are planted between Rubber and Coconuts

(2) CASSAVA.

Expenditure on an acre planted say $3\frac{1}{2}$ feet by $3\frac{1}{2}$ feet :—

Cost of 450 Tapioca Stumps at a rupee per bundle of 100 sticks 6 feet long	Rs. 4'50
Cutting same to a length of 4 inches including transport	,, 2'50
Planting 2 cuttings to each hole made by mamoty dig	,, 2'50
Cutting down under growth, &c., twice at 2/50 per acre	,, 5'00
	Rs. 14'50

The tapioca should remain in a field only 8 months. From 6 months the yams will begin to be ready for the market and in 8 months they would be quite fit for digging. I do not advise growing more than one crop.

No holing is necessary ; just a mamoty dig, say about 3 feet to 4 feet deep and of a mamoty's breadth, is all that is required. The cooly should take care in planting the stems not to bury them completely.

In 6 or 8 months, the tapioca could be leased out from Rs. 50/- to 60/- per acre.

If the transport be easy and the yams well formed, say on an average 4 lb. to a tree, one could safely expect Rs. 60/- to Rs. 75/ per acre. An acre of a good cassava field should give 12 to 14,000 lb. of cassava.

Our field of tapioca about 25 acres, gave us an average about 4 lb. to a bush, and the price here is from Re 1/- to 1/12 per cwt. In the neighbouring villages, cassava has brought in from Rs 80/- to 90/- per acre. This is of course, where the fields are good and the transport easy.

The best month for this plantation is in October.

After removing the tubers, the stems and leaves should be chopped and used as manure after drying.

Such records as are produced above are of the greatest interest and utility and it is to be hoped that other members of the Society will follow this planter's example and furnish the Agricultural Society with the results of their planting experience. He will be glad to afford any further information that may be required.

C. D.

FATTENING PIGS ON CASSAVA.

The writers (A. GOUIN and P. ANDOUARD) continuing PROFESSOR FRATEUR'S experiments in feeding pigs on cassava, made some trials, and found that the method recommended by PROFESSOR FRATEUR might be profitable in Belgium, where cassava is obtainable for 12 or 13 francs per 100 kg. (4*s*. 10*d*. to 5*s*. 3*d*. per cwt.), but that it could not be followed in France, where cassava costs 18 fr. the 100 kg. (7*s*. 3*d*. per cwt.).

With a view to finding a more economic use for cassava, the writers made some experiments of their own with the following results.

1. In the case of pigs fed with milk as well, it only took 3 lb. of cassava to produce a gain in live weight of 1 lb., instead of the 4·18 lb. of cassava required at Louvain.

2. By substituting for the milk ration 1·1 lb. of rice gluten and 2½ oz. bone meal, which costs 1*d*. and is equivalent to 1 gallon of separated milk, there is required, to produce a gain of 1 lb. to live weight, only 2·9 lb. of cassava.

In practice, the profit exceeded 40 per cent.

PROFCSSOR FRATEUR fed the cassava to the pigs in slices, cooked and then crushed. The writers fed it raw. It had been previously chopped fine in the colony itself.—MONTHLY BULLETIN.

BRITAIN'S TROPICAL GARDENS AND WHAT THEY HAVE DONE.

From one of those old "medicine gardens" dates the beginning of the wonderful establishment at Kew, England, which every amateur botanist in the world dreams of some day visiting. Slowly developing under successive owners through several centuries, the estate was leased as a residence by the unfortunate Frederic, Prince of Wales, and here his widow reared her son, who afterwards as George the Third, had an interesting difference of opinion with his American subjects on matters of taxation and kingly rights. That monarch obtained the freehold, enlarged the grounds and continued the improvements made by his parents. In 1840 the Royal Botanic Gardens, as they had come to be called, became definitely a public institution, which remains to-day the most important botanical establishment in the world. It has had associated with its conduct the immortal names of Hooker and Bentham, and it has added to botanical science a fund of knowledge which may never be equalled until there is another world to explore.

But Kew is more than grounds, gardens, collections and treatises. It is a great institution for the study of plants from every possible angle, their relationships, their habitats, industrial importance, climatic and soil requirements, their diseases and a hundred other matters. It is a world institution, not only having correspondence with learned bodies and individuals everywhere, but having what are practically branches in the shape of botanical gardens, forest observatories and experiment stations in all parts of the British empire.

This work was given great impetus by Sir William Turner Thistleton-Dyer, who was director of Kew from 1875 until 1905, when he became Botanical Adviser of the Colonial Office. Under his influence the usefulness of Kew to all mankind has been strikingly increased. A sound economist and man of imagination and breadth of view, as well as a thorough scientist, he saw that the problem of tropical production was not merely to make money for exploiters, but to furnish the products in abundance and at reasonable cost to those who had need for them. To do this meant that the right plants must be grown in the right localities by the right methods. The natives, on whose efforts the success of plantations depended, could be interested only by remuneration which would distinctly raise their standard of living, and this could be given only where right methods of crop-selection and culture were followed. To this humane and broad-minded policy the botanical work of the empire was definitely committed. The survey swept the world. If a plant had beauty or utility the question of its culture and extension was considered. No dictum derived from empirical knowledge stood in the way of a candid examination of any problem presented. To find the plant, then find the way to make its culture profitable, was the work to which Kew and its allies addressed themselves; and the results have been of incalculable benefit to the world.

PERADENIYA.

The Botanical Gardens of Peradeniya, in Ceylon, have been declared the finest in the world. They are nearly a century old, having been established in 1821. The grounds are bounded on three sides by the river Mahaweliganga and are only four miles from the historically interesting town which bears the alluring name of Kandy. For a hundred years high talent, devoted enthusiasm and deep scientific knowledge have been given to the work of making these wonderful gardens. The same patient and skilful effort would have wrought wonders in Greenland, but under a tropic sun the result has been magnificent beyond description.

The Mohammedans believe that the Garden of Eden was located in Ceylon, and there is no doubt that the gardens of Peradeniya have made a finer representation of that ideal spot than imagination could ever depict. The beauties, the marvels of the vegetable world, the delightful fruit, the healing herb, all are there—and there is no angel with flaming sword to turn the visitor away. Avenues of lofty palms, wonderful lianas, giant bamboos and all those miracles of the vegetable world which loom so large in travellers' tales are here assembled for the visitor's delight. There are flowers of marvellous beauty and, as in the Garden of old, "every tree that is pleasant to the sight and good for food." There, too, is the tree of the fruit of which if man should eat he would surely die. It is the upas-tree of Java.

This bewildering assemblage of beauty and marvel would well justify its existence if it served no further purpose than the information and delight of the visitor. But for the benefit of the grouchy utilitarian it may be said that they have added many millions (now we have him interested!) to the wealth of the world and there is scarce a household in civilized lands to which their benefits have not penetrated. Tea was imported into Ceylon for a thousand years. No doubt small, unsuccessful and forgotten attempts at its culture were made, but not until Peradeniya, by scientific and careful experiment, had shown the way, was the tea plant more than a curiosity. In 1875 a little less than three hundred pounds were exported. Now the production is two hundred million, twice the amount consumed in the United States. How much this means to the planter in Ceylon and the patient, humble workers of that land may be partly appreciated, but what it means to the millions of tea drinkers of the world, particularly among the poor, is beyond human computation.

CINCHONA.

The cultivation of cinchona is another illustration of what the botanic stations may accomplish. In the late seventies the culture had begun, but the commercial supplies still came from the bark of the wild trees, harvested by the usual destructive methods. Supplies of quinine sold for ninety dollars a pound and people sickened and died because they could not pay the price. Now thousands of tons of the life-saving bark come from plantations of the East and the drug can be purchased at retail in New York for thirty-five cents an ounce.

RUBBER.

But it is with the production of rubber that the most commercially important work of the botanic stations of Ceylon, Singapore and the East generally has been concerned. In showing how recent is the cultivation of rubber-producing plants perhaps the most impressive fact which may be cited is that in DE CANDOLLE'S "Origin of Cultivated Plants," revision of 1884, not a single rubber plant was considered worthy of mention in the list of 247 species, though careful attention and exhaustive details were given in the case of such staples as skirret, rampion, quinoa, fenugreek, alexanders, sweet-sop, sour-sop and gold-of-pleasure. Ten years later saw the world unconvinced. Rubber importers scoffed. The forests were inexhaustible. Consumption would never catch up with the supply. Reputable writers, scientists and practical rubber men declared that rubber plantations were an economic failure. Misguided planters peevishly cut down their trees, replacing them with other crops, and this fact was trumpeted to the world. But the patient, clear-headed men at the experiment stations went on with their work. With sure and large vision they saw the enormous magnitude of the prize for which they were contending—not for themselves, but for their country and the world. They sent to America for plants—*Hevea*, *Castilloa*, *Manihot*. Foolish men! exclaimed the critics. Do they not know that those trees will not grow outside of their original habitat!

It seems that the foolish men at the botanic stations did not know anything of the kind. They went on planting, cultivating, tapping and testing, distributing trees and plants, until now thirty-eight years after the first trees were planted, a million and a half acres are set with the trees which "would not grow," and the product of the Malay States plantations alone is greater than was the whole world's production of rubber at the time the first experiments were being made. It seems certain that within a very few years the plantations of the East will furnish by far the largest part of the world's rubber supply.

Such has been the work of a few men of intelligence, imagination, conscience and energy, working mostly for salaries less than that of the chief cook in a modern hotel. While their critics were giving dire reasons why it never could be done these men were learning the requirements of the plant, placing it under the right sky, in the right soil and at the right elevation; they were testing every possible mode of culture and recording the results, noting failures as calmly as they noted successes; applying the science of chemistry to the product, making and testing the goods the world would want. They are still at their tasks in their quiet laboratories and gardens, still adding to the world's knowledge and the world's wealth and training the clear-eyed and clear-brained young men who are to come after them; while their erstwhile critics in far off lands are riding above tyres made from the rubber they declared could never be grown.

It we consider the condition which the world would be facing if its supply of this indispensable article rested with those in control of the native forests; when we think of how the concessionaires would be calling for their pound of flesh and on second thought declaring that they must have two pounds; of the Government's planning for more and more revenue and concocting schemes of monopoly and "valorization;" when we think of the continued destruction without replacement and a narrowing supply which stands between the manufacturers and the certain famine which would now be at hand.

In every land the policy of the stations is adapted to the facts which must be faced. In some parts of Africa the easygoing natives could never be induced to undertake plantations, and here they are skilfully persuaded to make each for himself a small planting in the forest near his own hut. They are taught less destructive methods of tapping; they are protected from exploitation and encouraged to become regular producers who will be more and more efficient as the years go by. All over the world the combined resources, learning and effort of the botanic establishments of the British Empire are directed to the task of teaching mankind how to profit in pleasure and wealth from the boundless treasures of the vegetable world. The man who discovers a gold mine does a poor and paltry thing compared with that done by the man who shows how an acre of ground can be made to yield pleasure and wealth for the succeeding generations of all the ages that are to come.—
India Rubber World.

ORIGIN OF BALATA.

C. K. BANCROFT, M.A., F.L.S.

The trees from which this product is obtained are found growing in the forest all over the colony, but more particularly on the lower lands along the banks of the rivers and creeks. In the county of Berbice the balata collecting industry has been well established for more than thirty years and in some parts of the county a large proportion of the male inhabitants are engaged in the industry.

The trees are, perhaps, most abundant in the county of Berbice, but large forests occur on the upper Essequibo, Potaro and Mazaruni Rivers.

The trees may be scattered through the forest or may occur in reefs composed mainly of balata trees.

The products obtained from different parts of the colony vary little in composition, and the bulk of the exported balata is probably obtained from one species of tree, *Mimusops globosa*

Another product known as brittle balata, which differs from commercial balata in possessing no elasticity, is also known to be obtainable from a species of *Mimusops* hitherto unidentified. It has at present no commercial value. It contains when dry 30 per cent. of gutta of a high quality.

COLLECTION AND PREPARATION.

The collection of balata is carried out under licenses issued by the Government. For the purpose of the administration of balata collection the colony is divided into sections of 50 or 250 square miles in area, the former in the more readily accessible and the latter in the less readily accessible parts of the colony. A separate licence is issued for each section and confers the right to collect wild rubber as well as balata. The terms are for not more than 15 years, an application fee of £1 13*s.* 4*d.* and an annual rental of £4 3*s.* 4*d.* for each license, and a royalty of 1*d.* per lb. on all balata and wild rubber collected. The licenses are issued for collecting only and may be cancelled if the land is required for agricultural or mining purposes. The collection is carried out by Negroes and Aboriginal Indians who are registered as bleeders. No tree is allowed to be bled which does not measure 36 inches in girth at four feet from the base. Trees may be bled on one-half of the circumference only at any one time. No tree is allowed to be re-bled until five years have elapsed from the previous bleeding. The cuts employed for extracting the milk must be not more than 1½ inches wide and not closer than 10 inches.

The collectors proceed to the grants from January to April and the work generally commences towards the end of May and extends to the beginning of October. The collectors are paid by the weight of balata obtained.

Bleeding is done by means of a cutlass ; the incisions are 10 inches apart and are arranged in a feather-stitch pattern. Bleeding is commenced at the base of the tree and extends to the main fork ; the branches of trees are seldom bled. The milk is collected in a calabash (made from the fruit of *Crescentia cujete*), placed at the bottom of the tree and held fast by inserting its lip between the bark and wood of the tree. The first bleeding is done while the collector is standing on the ground ; the parts of the trunk situated higher up are bled by the aid of a ladder roughly constructed in the forest, while the highest parts are frequently reached by the aid of a rope for climbing.

The latex is transferred from the calabashes to kerosine tins and taken to the camp where it is poured into a shallow tray (dabree) and allowed to evaporate. This tray is constructed generally of pieces split from the stem of a palm. The latex coagulates by evaporation and the gum is removed in successive sheets from the top to the bottom.

YIELD PER TREE.

The yield varies up to certain limits according to the age and size of the tree. Speaking generally five pounds of dry gum per tree is considered a good yield.

EXPORTS.

The total export of balata from the Colony for the year 1913 was 1,323,609 lb. of the value of $768,463. The greater part of this went to the United Kingdom, the remainder going to the United States of America and to Holland.—BR. GUIANA PAMPHLET.

PALM OIL IN TOGOLAND.

The oil palm, the most important cultural plant of tropical West Africa, extends eastward only as far as the Great Lakes. Accordingly it is only of subsidiary importance to German East Africa, but of very great importance for Togo and the Cameroons. In Togo compact masses are to be found in the Southern and Central districts, and in the Cameroons there are very many of them in the virgin forests of the lowlands.

The most valuable products of the oil palm for the native are palm wine, palm kernels, and palm oil, the two latter being at the same time important articles for exportation. The method hitherto employed by the natives for obtaining palm oil and palm kernels is most primitive; the oil as a rule contains over 20 per cent. of fatty acid, and is therefore not suitable for use in Europe as a foodstuff, but only for soap manufacture.

As palm kernels are for the most part only obtained in connection with palm-oil extraction, and are only used to a small extent by the natives themselves, the actual exportation of palm kernels supplies data for estimating the minimum quantity of palm oil produced in the districts open to trade. From this it appears that both in Togo and the Cameroons more than four-fifths of the total quantity of palm oil is consumed by the natives themselves, and barely one-fifth is exported.

The export of palm oil from the Cameroons steadily remains about 3,000 tons, whereas in consequence of periodically occurring periods of drought the exportation from Togo fluctuates between 400 and 4,000 tons. It cannot be ascertained whether the market price affects the extent of exportation.

An increase in exportation may be attained by the following measures :—

(1) An extension of the districts capable of exporting by improvements in the means of communication (construction of railways).

(2) A more intensive utilization of the existing palms through better methods of cultivation.

(3) A better utilization of the crops obtained through improved methods of preparation.

(4) An increase in the existing number of palms by increased activity of the present producers or the introduction of fresh producers (European plantation cultivation).

The methods of preparing the crop by machinery that have been elaborated within the last decade are of special interest, among which the process employed at the Agu plantation in Togo supplies the best palm oil obtained at the present time, containing only 5 to 6 per cent. of fatty acid. Only these recent methods make it possible for the cultivation of the oil palm to be taken up in the form of European plantations—Agricultural News.

COFFEE PLANTING IN TONKIN.

M. BOREL.

The coffee bush is little pruned in Tonkin owing to the borer (*Xylotrechus quadranipes*,) which causes so much damage on plantations that planters allow suckers to grow in order to furnish a substitute for the parent bush when the latter is attacked by the beetle. On the other hand the bushes are kept low by being topped as soon as they are one year old in order to develop the lower branches and expose the young plant less to the action of the

wind. Usually the trunk is not allowed to grow above 5 ft. making with the uppermost branches a total height of 6 to 6½ ft. which could not be increased without letting some of the fruit get out of reach of the pickers.

Manurial requirements per bush are : 55 lb. of dung every two years ; ¾ oz. of nitrogen, 1 oz. phosphoric acid and 2½ oz. of potash every year ; and every three years a dressing of lime varying in amount with the nature of the soil.

The yield per bush varies from ½ lb. to 2 lb. of coffee, with an average of about 1 lb. Approximate estimates of expenses and returns on coffee plantations are as follows :—

A—PLANTATION OF 50,000 BUSHES.

Total cost of establishing plantation spread over 4 years ...	£4,310
Expenses during 5th year	1,188
Sales during 5th year: 44,000 lb. of Coffee	1,804
Live stock run on the plantation	225
Total sales ...	£2,029
Total profit	841
Less 15 per cent. to Manager...	126
Net returns ...	£ 715

or a return of 16·6 per cent. on a capital of £4,310 over and above a 5 per cent. interest on capital allowed for in estimated expenses.

B—PLANTATION OF 160,000 BUSHES.

Total cost of establishing plantation spread over 4 years ...		£10,512
5th year :		
Expenses	Estimated to counter- ...	3,267
Receipts	balance one another ...	3,310
6th year :		
Expenses		3,375
Receipts		6,505
Total profits	£	3,130
Less 15 per cent. to Manager		470
Net returns	£	2,660

or a return of 25·3 per cent. on a capital of £10,512 over and above a 5 per cent. interest on capital allowed for in estimated expenses.—MONTHLY BULLETIN.

MADAGASCAR VANILLA.

A. FAUCHERE.

Vanilla is successively cultivated on various kinds of soil in Madagascar, not only on granitic alluvial soils, but also on the sandy soils of the coast and on basaltic or volcanic soils, though the two latter kinds are perhaps the most suitable. From a series of analyses carried out by the writer it would seem that a soil with a high phosphoric acid content is specially good, the best at Nossy-Bé containing a minimum of 0·4 per cent. and that of the most productive plantation containing 0·75 per cent.

The most usual shade and support tree is *Jatropha Cureas*, but *Dracæna tesselata* is also frequently used. Vanilla cuttings should always be at least 5 feet long; they cost 2*d*. to 2½*d*. each. Decomposed banana stems are frequently used as manure in vanilla plantations.

The production of vanilla in Madagascar has been increasing of recent years. The figures for 1903-1912 are as follows:—

		Amount	Value
		tons	£
1903	...	11·5	8,264
1904	...	9·1	6,892
1905	...	30·4	18,619
1906	...	40·0	19,029
1907	...	50·0	39,875
1908	...	56·4	41,748
1909	...	42·6	47,639
1910	...	42·2	50,846
1911	...	51·7	40,986
1912	...	112·0	142,217

Further increases are anticipated, but over-production will be checked by the growing practice of planting other crops in vanilla districts.

Plant bugs are destructive to vanilla in Madagascar, especially *Memia viccinia* which punctures the pods and young buds, causing them to fall. Preventive measures have not yet been thoroughly investigated, but it would seem that the only means of checking the parasite would be treatment with hydrocyanic acid.

An average yield of vanilla in the green condition would amount to 530 lb. per acre, while expenses of establishing the plantation are estimated as follows:—

	per acre £ s
1st year—clearing ground, planting shade and support trees, planting vanilla cuttings, 3 hoeings.	14 7
2nd year—3 hoeings, cutting shade trees, replacing cuttings ...	5 17
3rd year—as 2nd	5 17
4th year—as 2nd, pollination (22*s*) and harvest (14*s*)	7 13
	£ 33 14.

—MONTHLY BULLETIN.

MOCHA COFFEE IN ARABIA.

M. RIES AND P. BARDEY.

Mocha coffee derives its name from the small ruined town on the South Arabian coast of the Red Sea from which it used to be exported. It is an absolutely unique product with a flavour and aroma quite distinct from the Abyssinian variety, though many writers consider them identical.

The tree is cultivated in the province of Yemen, South-western Arabia, on terraced slopes, a southern aspect being preferred. The seeds, after being separated from the pulp, are rolled in ashes and preserved in a dry place. Seedlings are raised in nurseries on a fertile and well manured soil; they are protected from the sun, watered frequently and transplanted once or twice before being finally planted out 2 to 3 yards apart. Plantations are all in the immediate neighbourhood of wells, as irrigation is absolutely necessary; the soil has to be kept loose and permeable by repeated

cultivations. The crop is harvested continuously from August to March; the seed is hulled in a small stone mill, spread out to dry and packed in bags made of woven aloe fibre (sanseviera) and lined inside with the leaves of the palm tree (doum), this packing being known in the trade as the Mocha bag and constituting a kind of certificate of origin.

The trees belong to three main types: (1) pyramidal with the biggest branches at the base; (2) umbrella shape with the lower part of the trunk bare; (3) bush shaped.

In the low regions where rain is abundant, the fruit is larger but of inferior quality; in the hot dry uplands, growth is slower and the grain is smaller and rounder, but of the finest quality.

The annual production of Mocha coffee is about 100,000 bags 160 lb. each, and the principal importing countries are the United States which takes 30 per cent., France which takes 20 per cent. and Egypt which takes 18 per cent., others being the Red Sea ports (7 per cent.), Germany (5 per cent.), England (5 per cent.), Spain (3 per cent.), and Austria (3 per cent.). About half the amount is exported from Aden, and half from Hodeidah.—MONTHLY BULLETIN.

THE WINNING OF NEW LAND FOR AGRICULTURE.

A. D. HALL, M.A., F.R.S.

Before dealing with the process by which the rough places of the earth are to be made straight, there is one general question which deserves consideration: Is it more feasible to increase the production of a given country by enlarging the area under cultivation, or by improving the methods of the existing cultivators? There is without doubt plenty of room for the latter process even in the most highly farmed countries: in England the average yield of wheat is about 32 bushels per acre—a good farmer expects 40; the average yield of mangolds, a crop more dependent upon cultivation, is as low as 20 tons per acre when twice as much will not be out of the way with good farming. A large proportion of the moderate land in England is kept in the state of poor grass—even as grass its production might be doubled by suitable manuring and careful management, while under the plough its production of cattle-food might easily be trebled or quadrupled. Why, then, trouble about adding to the area of indifferent land when so much of what has already been reclaimed, upon which the first capital outlay of clearing, fencing, roadmaking, etc., has been accomplished, is not doing its duty? We are at once confronted by the human factor in the problem. The existing educational agencies which will have to bring about better farming will only slowly become effective, and however imperfect they still may be in England, they are mainly so because of the lack of response upon the part of farmers. The present occupiers of the land do obtain in many cases a very inadequate return from it, but they make some sort of a living and they hold it up against others who, though they want land, cannot be guaranteed to use it any better. Improved farming means more enterprise, more knowledge, often more capital, and the man who can bring these to the business is far rarer than the man who, given a piece of land even of the poorest quality, will knock a living out of it by sheer hard work and doggedness. While, then, there should be no slackening in our efforts to improve the quality of the management of existing land, there is a case for also using every effort to increase the cultivable area; indeed, it is probable that for some time to come the second process will add most to both the agricultural production and the agricultural population.

Let us now consider what are the factors which determine the fertility of the land that is first brought into cultivation and remains the backbone of farming in the old settled countries. Foremost comes rainfall, and the distribution is almost as important as the amount. Winter rain is more valuable than summer, and though cereal growing is none the worse and may even obtain better results with a rainless summer, stock-raising and the production of fodder crops are the better for a rainfall that is distributed fairly evenly throughout the year. Rainfall, again, must bear some relation to temperature; some of the best farming in the Eastern counties of England is done on an average rainfall of 20 inches; there are great areas in South Africa with the same average rainfall that are little better than desert. In temperate regions we may say that the naturally fertile land requires a rainfall of from 20 to 50 inches per annum, not too much segregated into seasons and some at least falling in the winter.

If the rainfall is excessive or the drainage inadequate to carry it off, the formation of peat is induced, resulting in such uncultivated areas as the bogs of Ireland and the moors of Eastern England, Holland and Germany.

Given suitable rainfall and temperature the texture of the soil becomes a factor of importance; if too coarse and sandy, so little of the rainfall is retained that we get all the effects of drought secondarily produced. In itself the open texture of a coarse, sandy soil is favourable to plant development; under irrigation, or where the situation is such as to result in permanent water a short distance below the surface, fine crops will be produced on sandy soils that would remain almost barren if they only depended upon the rainfall for their water. In Western Europe large areas of heaths and waste land owe their character to the coarse and open texture of the soil. At the opposite extreme we find clays so heavy that their cultivation is unprofitable; such soils, however, will carry grass and are rarely left unoccupied. For example, in the south-east of England there are a few commons, i. e., land which had never been regarded as worth enclosing and bringing into particular ownership, situated on heavy clay land, most of such land is pasture, often of the poorest, or, if at any elevation, has been covered with forest from time immemorial.

One last factor in the soil is of the utmost importance to fertility, and that is the presence of lime—of calcium carbonate, to be more accurate—in quantities sufficient to maintain the soil in a neutral condition. Old as is the knowledge that lime is of value to the soil, we are only now beginning to realise, as investigation into the minute organisms of the soil proceeds, how fundamental is the presence of lime to fertility. A survey of the farming of England or Western Europe will show that all the naturally rich soils are either definitely calcareous or contain sufficient calcium carbonate to maintain them in a neutral condition even after many centuries of cultivation. Examples are not lacking where the supply of calcium carbonate by human agency has been the factor in bringing and keeping land in cultivation. I have discussed one such case on the Rothamsted estate, and several others have come under my notice. The amelioration of non-calcareous soils by treatment with chalk or marl from some adjacent source has been a traditional usage in England and the North of France: Pliny reports it as prevailing in Gaul and Britain in his day, and the farmer of to-day often owes the value of his land to his unknown predecessors who continuously chalked or marled the land. Upon the presence of carbonate of lime depends the type of biological reaction that will go on in the soil, the beneficial bacterial processes that prepare the food for plants only take place in a medium with a neutral reaction. The Rothamsted soils have provided two leading cases. I have shown that the accumulation of fertility in grass-land left to itself and neither grazed nor mown, so that virgin conditions were being re-established,

was due to the action of the organism called Azotobacter, which fixes free nitrogen from the atmosphere, and was indirectly determined by the presence of calcium carbonate in the soil, without which the Azotobacter cannot function. Examination of typical examples of black soils from all parts of the world, the prairies of North America, the steppes of Russia and the Argentine, New Zealand and Indian soils, showed in all of them the Azotobacter organisms and a working proportion of carbonate of lime. Now, as we know, all virgin soils are not rich, and only in a few parts of the world are to be found those wonderful black soils that are often several feet in depth and contain 10 to 20 per cent. of organic matter and three to five parts per thousand of nitrogen. These soils are all colcareous, they occur in regions of a moderate rainfall including grass-steppe or bush conditions, and the annual fall of vegetation provides the organic matter which the Azotobacter requires as a source of energy in order to fix nitrogen. Non-calcareous soils under similar climatic conditions do not accumulate nitrogen and become rich; in the absence of carbonate of lime the nitrogen fixing organisms are not active, and the soil only receives from the annual fall of vegetation the nitrogen that was originally taken from it. There is but a cyclic movement of nitrogen from the soil to the plant and back again, whereas in the calcareous soils there is also continuous addition of fresh nitrogen derived from the atmosphere, in which process the carbonaceous part of the annual crop supplies the motive power.

The other leading case to be found at Rothamsted is that of certain grass-plots which have artificiaily been brought into an acid condition by the continued application of sulphate of ammonia. In these soils nitrification is suspended, the nitrification organisms have even disappeared, though the herbage still obtains nitrogen because most plants are able to utilise ammoniacal nitrogen as well as nitrates. The interesting feature, however, is that the decaying grass on these acid soils passes into the form of peat, a layer of which is forming upon the surface of the soil, though nothing of the kind is found on the adjacent plots where the use of lime or of alkaline manures has prevented the development of the acidity. From this we may learn that the development of a surface layer of peat, independent of waterlogging (when another kind of peat forms even under alkaline conditions), is determined by the acidity of the soil, when certain of the bacterial processes of decay are replaced by the changes due to micro-fungi which do not carry the breaking down of organic matter to the destructive stage. This affords us a clue to the origin of many areas of upland peat in the British Isles, where the remains of ancient forest roots and stumps of trees are found on the true soil surface below the layer of peat, but where there is no waterlogging to bring about the death of the trees and the formation of peat. We may suppose that when the land surface became fit for vegetation at the close of the glacial epoch it covered itself with a normal vegetation, chiefly dwarf forest, because of the rainfall and temperature. The soil, however, being without carbonate of lime, would in time become acid with the products of decay of the vegetable matter falling to the ground, and as soon as this acid condition was set up peat would begin to form from the grassy surface vegetation. The process would continue until the acid conditions and the depth of the accumulating layer of peat would kill the trees, the stumps of which would remain sealed up below the peat. I am far from thinking that this explanation is complete, but at least we have facts in sight which could lead one to suppose that a non-calcareous soil originally neutral and carrying a normal vegetation can naturally become acid, alter the character of its vegetation, and clothe itself with a layer of peat. The point of economic importance is that these peaty acid soils are of very little value as long as they are acid, though they take on a quite different aspect if they are limed and made neutral.

Of all the soil factors making for fertility I should put lime the first; upon its presence depend both the processes which produce available plant food

in quantities adequate for crop-production at a high level and those which naturally regenerate and maintain the resources of the soil; it is, moreover, the factor which is most easily under the control of the agriculturist.

I need say little about those cases in which infertility is due to presence in the soil of some substance which is actually injurious to plant-growth, because such substances are nearly always due to the physical environment of the soil, too much or too little water. In waterlogged situations we may find in the soils peaty acids, iron salts, sulphides, etc., inhibiting the growth of plants; in arid regions the soil may still be charged with an excess of soluble compounds of the alkalis and alkaline earths, resulting from the decomposition of the rocks that have been broken down to form the soil, but which through the inadequate rainfall have never been washed out. The establishment of normal conditions of growth, irrigation in one case, drainage in the other, will speedily result in the removal of the deleterious substances. Practically, only bodies that are soluble can get into a plant to injure it, hence such bodies can be removed from the soil by water, provided that the water can find its way through the soil and escape.—ADDRESS TO THE BRITISH ASSOCIATION.

"WHAT HE COULD DO."

Under this heading the SPECTATOR of September 12th has a piece of poetry by E. BAKER describing how JOHN SMITH ESQUIRE, of Shepherd's Bush, sixty-six and hearty, being too old to serve in the ranks was sore at heart; feeling the obligation for more personal work than subscribing to funds, valuable as was such aid. Then on a happy day he saw a plan to help the nation: let open spaces be employed, he said, for useful cultivation; and proceeded to dig up his dahlias and plant vegetables: "to give his share in case of need towards the nation's larder." The verses were inspired by a suggestion that had been made that open spaces and waste lands should be utilised for growing vegetables, and concludes as follows:—

"Let those who feel inclined to smile
Respectively enquire
If they are doing all they can
As does John Smith Esquire."

Members of the Ceylon Agricultural Society who from whatever cause are debarred from going to the front all desire, we are sure, to do what they can, and those who have land could not serve the country better than by emulating the example of JOHN SMITH, thereby raising up by their example other JOHN SMITHS.

Thousand packages of vegetable seeds have been distributed from Peradeniya during the last three weeks.

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Fowls **Rs. 18, 15, 10·50,** and **Rs. 9** per dozen. Ducks **Rs. 15,** Geese **Rs. 60,** Turkey cocks **Rs. 120,** Turkey-hens **Rs. 90** per dozen.
Guinea fowls **Rs. 48,** Pigeons **Rs. 6,** Partridges **Rs. 6,** per dozen
Quails to order.
Pigs, Porkers, **cts. 35** per lb. live weight, Sucklings **Rs. 7·50, 5** and **3.**
Eggs, fresh, **75 cts.** per dozen.

Telephone 1087 and 285. **Telegrams: Wally, Colombo**

Usual discount to the TRADE.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¼ d a 4½d
	Renewed	3d a 5½d
	Root	1⅝d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅝d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10/
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
,, ,,	red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
	Crepe ordinary to fine	2/2½
Ceylon, Straits. ,,	Fine Block	2/4¼
Malay Straits, etc. ,,	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
,,	Fair to fine ball	1/9 a 2
Nyassaland ,,	Fr. to fine pinky & white	1/4 a 1/6
Madagascar ,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
,,	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang per lb.	Pale reddish to fine	2/4 a 2/6
	Ordinary to fair	2/ a 2/2
Java ,,	,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2½d
NUTMEG ,,	Dingy to white	1½d a 1⅞d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅜d
Singapore ...	Fair	4⅝d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8¼d a 8¾d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅞d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large--cwt	Fair to fine	18/
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10/ a 11/
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

Photo by H. F. Macmillan

THE "CLUSTER" VARIETY OF SWEET-POTATO.
(*Ipomoea Batatas.*)

Photo by H. F. Macmillan

A FIELD OF SWEET-POTATOES, NEAR KANDY.
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